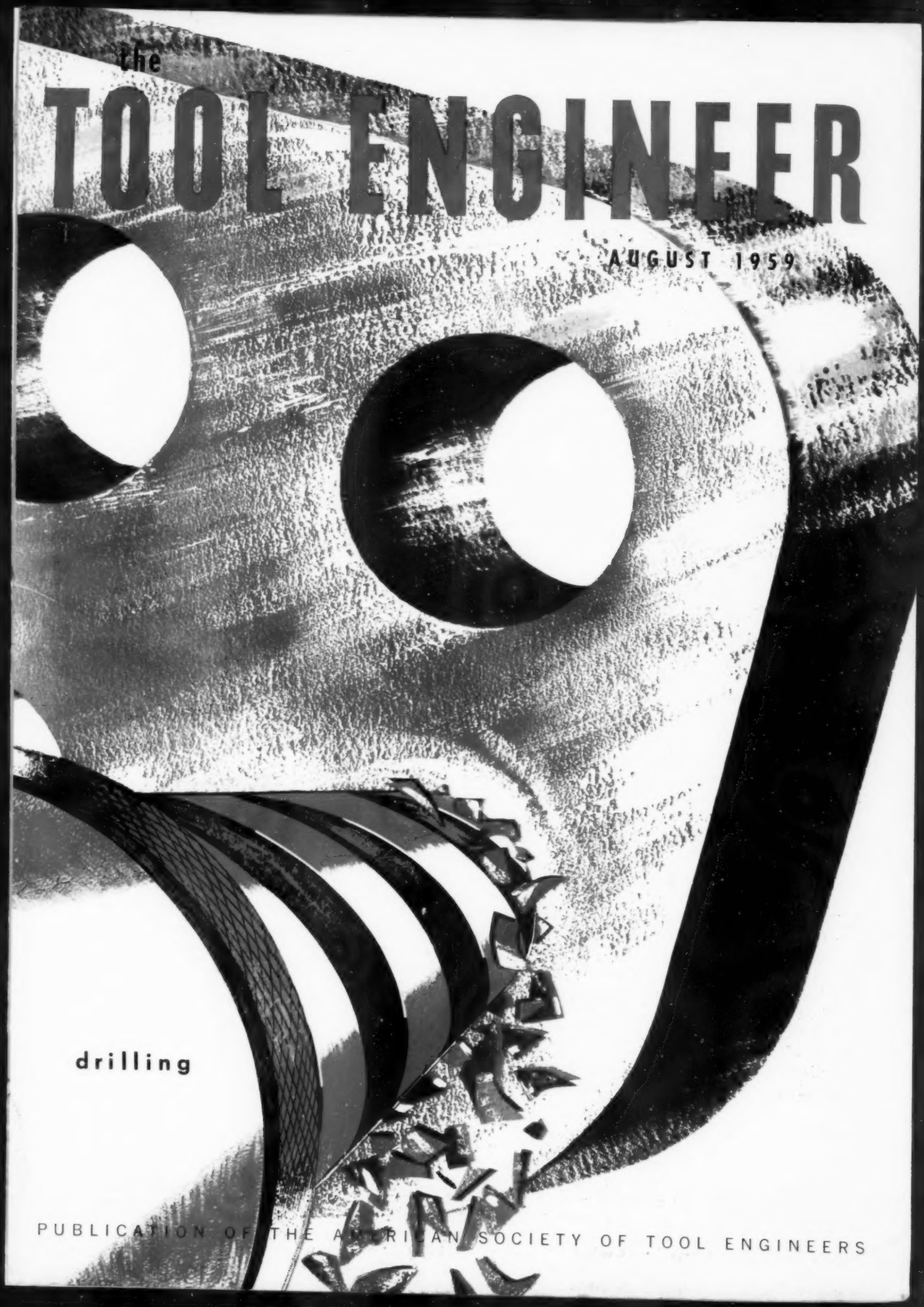
the
TOOL ENGINEER
AUGUST 1959
drilling
PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS

Two Heald Model S Bore-Matics installed in diesel engine plant for rough and finish boring cast iron cylinder liners. Unit in foreground performs the roughing operation, with capacity of up to ¼" of stock removal on four parts at a time, followed by finish boring on identical machine at the right.

HEALD

KING-SIZE BORE-MATICS

rough and finish bore diesel cylinder liners FOUR AT A TIME

HEAVY-DUTY roughing and precision finish boring are the dual functions of the two Heald Model S Bore-Matics shown above. Installed in a large diesel engine plant, these huge, 40,000-pound machines are identical except for tooling — each handling four large cast iron cylinder liners at a time.

One machine, used for the roughing operation, is capable of removing a full quarter inch of stock — the other is used for finish boring to close tolerances for size and concentricity. Each four-station machine is equipped with a hydraulic clamping fixture and operates on a fully automatic push-button-controlled cycle. Total cycle time is 266 seconds on the roughing operation, with a net production of approximately 40 parts per hour.

These big vertical Bore-Matics are further evidence of Heald's ability to handle all phases of a machining operation from rough casting to finished part on any size work.

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

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the tool engineer

Vol. 43, No. 2 **August 1959**

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Versatile special machines, numerical control and efficient tooling lead to low-cost production of small lots.

Gadgets 47
Layout tool for contours . . . collet chuck holds tubing . . . flush pin rack gage . . . milling fixture reduces breakage.

Standard or Special Drills ..... *By Carl J. Oxford, Jr.* 50
Standard drills are usually the best choice but, in some cases, special drills give optimum performance, are worth their added cost.

Finishing Hard Materials at 300,000 rpm ..... *By T. W. Black* 55
High-speed pneumatic tool performs die finishing operations ten times faster than conventional equipment, even on carbides.

Air-Hardening Graphitic Steel ..... *By C. F. Jatczak, O. A. Pfouts and D. J. Girardi* 63
Graphitic tool steels are relatively easy to machine. Development of an air-hardening variety simplifies processing.

Tooling for Automatic Arc Welding ..... *By R. A. Wilson* 69
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Determining Effectiveness of Drawing Lubricants ..... *By Donald E. Eary* 83
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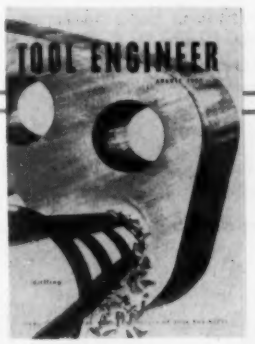
THIS MONTH'S COVER

Precision drilling operations are symbolized by this artist's version of high-speed machining in hardened steel. Principles of drill selection are discussed in an article starting on page 50 and an unusual tape-controlled drilling machine is described in an article starting on page 41.



THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and *Applied Science & Technology Index.*

There's nothing on the market like this amazing new machine, called the

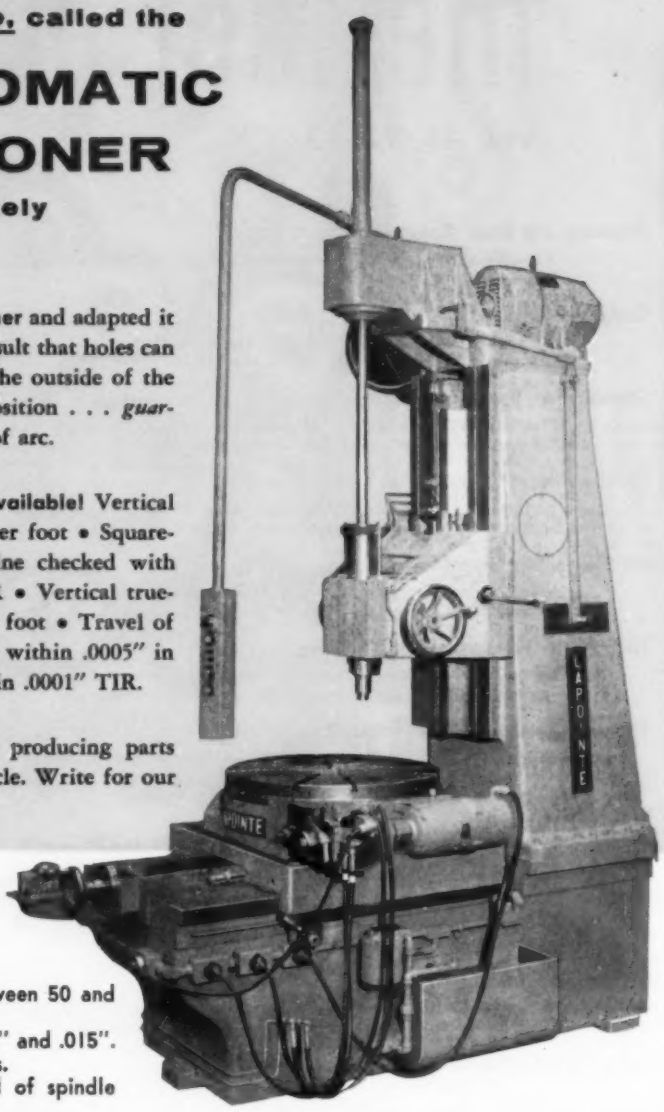
LAPOINTE AUTOMATIC HOLE POSITIONER

. . . which indexes accurately to ± 3 seconds of arc!

We took our 30"-table Rotomatic Positioner and adapted it to a precision jig boring head, with the result that holes can now be bored anywhere from center to the outside of the table within three seconds of arc of true position . . . *guaranteed!* It will repeat within one second of arc.

Such accuracy has never before been available! Vertical trueness of spindle center line is .0005" per foot • Squareness of table top with spindle center line checked with 15-inch sweep of tram within .0005" TIR • Vertical trueness of spindle slide is within .0005" per foot • Travel of table center coincides with spindle center within .0005" in 18 inches travel • Spindle runout is within .0001" TIR.

"Made to order" for any manufacturer producing parts with holes equally spaced on any bolt circle. Write for our new illustrated technical **Bulletin AHP.**



Other details:

Spindle speed: infinitely variable between 50 and 2000 RPM.
Feed: infinitely variable between .0015" and .015".
Longitudinal travel of table: 18 inches.
Maximum distance, table top to end of spindle nose: 30 inches.
Net weight: 12,500 pounds.
Although these features and dimensions apply to the Lapointe Automatic Hole Positioner as shown here, *they can be changed to accommodate your own requirements.*

Machine can be set up for automatic operation, through electrical interlocks. Can also be operated by tape control.

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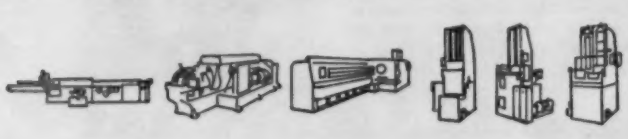

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New Tools for Tool Engineers

Many farsighted tool engineers have asked the question, what next? Rapid developments have caused them to wonder how specialized must a tool engineer become in order to keep abreast. He must be as informed as his counterpart in any plant. Otherwise, his production costs would soon be out of line with competition.

Some have expressed the fear that an engineer would be required to know more and more about less and less until he knew everything about nothing. Defining the specialist, this cliché seemed to be assuming a realistic meaning until recently.

Each new development adds to available production tools and fills a void. Each makes a logical addition from which to choose the best. Each seems to simplify instead of complicate.

Until a few years ago, numerical control looked improbable, particularly for control of machine tools. The early work at MIT only indicated how "impractical" it was. A roomful of control equipment was employed to operate a simple lathe. Prophets who discredited this type of control couldn't have been more wrong.

Tape control has already made job-lot automation possible. Methods for coding the tape have been simplified. It is practical to program an operation even though the need for future use seems remote.

Developments such as these show how industry aids the tool engineer. When a variety of dependable choices is available, he can more readily adapt one to his needs.

John W Greve

EDITOR

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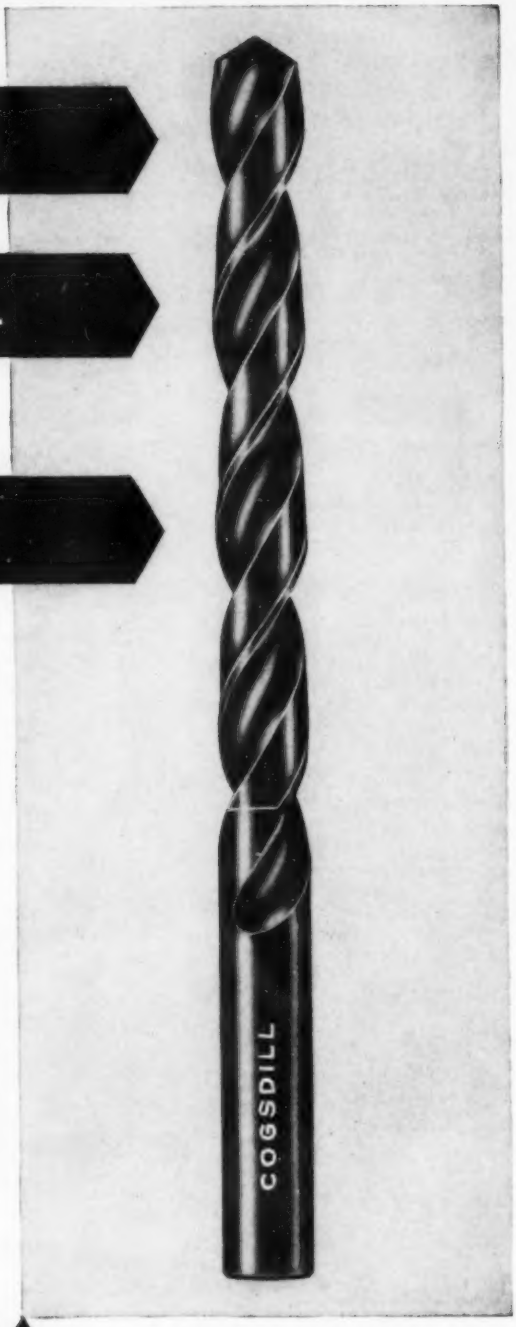

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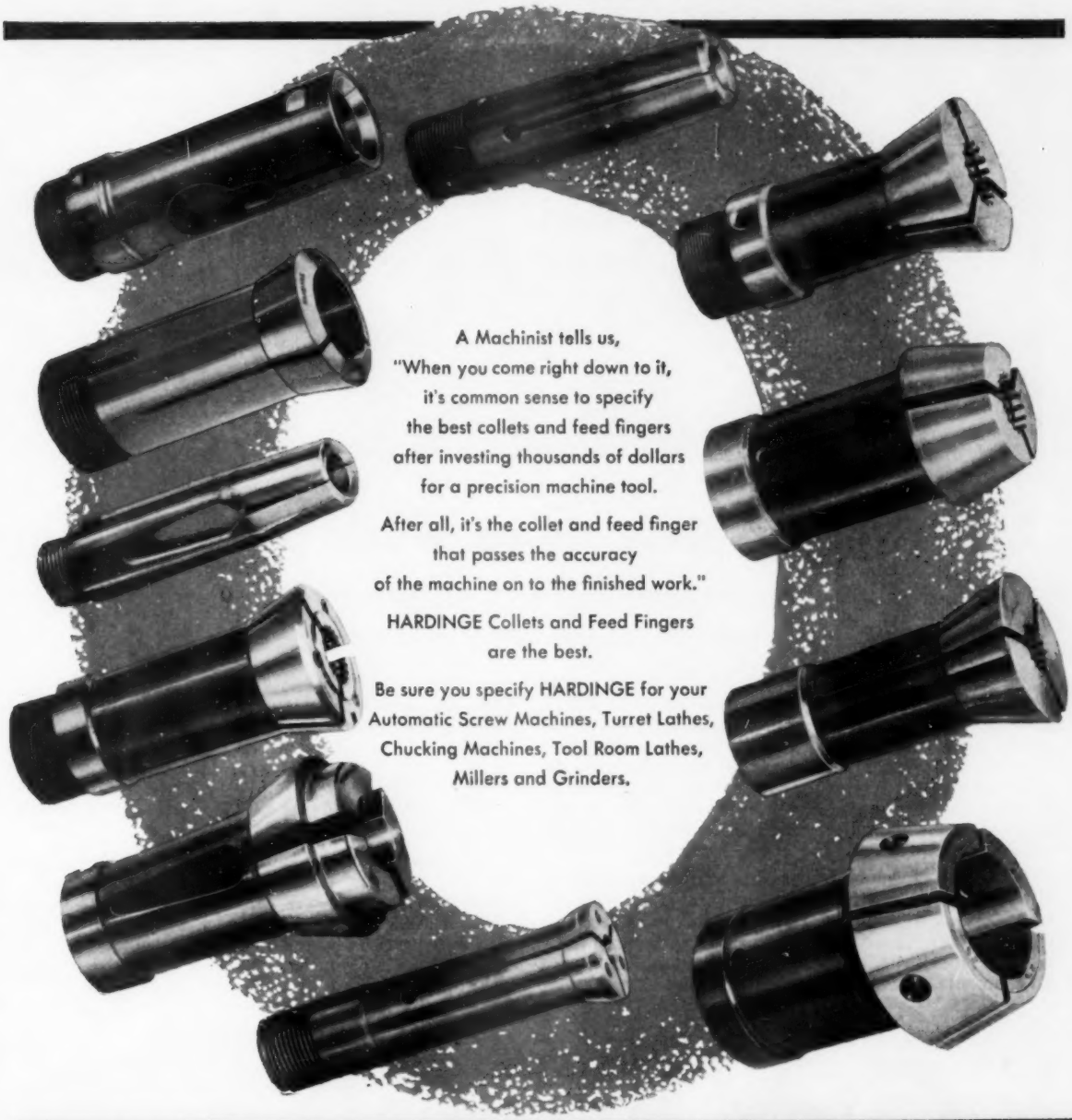

A Machinist tells us,
"When you come right down to it,
it's common sense to specify
the best collets and feed fingers
after investing thousands of dollars
for a precision machine tool.

After all, it's the collet and feed finger
that passes the accuracy
of the machine on to the finished work."

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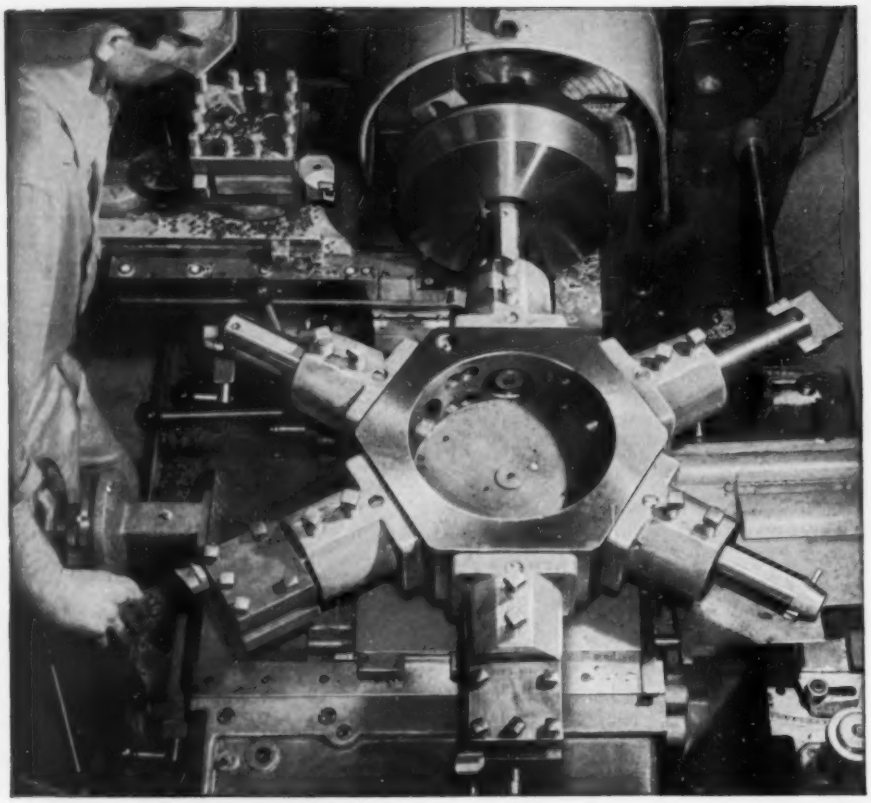

Expert setup gets more work per chucking

How manufacturer uses C/F turret lathe to produce variety of chuck bodies with only one tool change

To do the job, the manufacturer selected a Gisholt 1L Saddle Type Turret Lathe with a cross-feeding hexagon turret. A 15″ 3-jaw air chuck holds down chucking time. One set of adjustable serrated jaw bases handles the different workpiece sizes for first machining operations. A quick-indexing square turret on the cross slide carries turning, facing and chamfering tools, which work simultaneously with tools on the hexagon turret.

Three stub boring bars on the hex turret bore, counterbore, recess and back face. Because size is set with the cross-feeding turret, these same boring bars are used on different part sizes. Also on the hexagon turret are 2 box-type tool posts for facing, boring or recessing—used for different size workpieces because of the cross-feeding feature. A threading attachment lets the manufacturer thread the hubs, and a taper attachment handles up to 8 inches taper per foot when required.

The sixth tool on the hex turret, a spade cutter, is used for final sizing and is the only special tool changed for each job.

Simple, low-cost tooling combined with the cross-feeding hexagon turret offers maximum efficiency in handling various sizes of similar parts. The rugged Gisholt MASTERLINE Saddle Type Turret Lathes have the speeds, feeds and power to complete the work in the least amount of time. Call your Gisholt Representative today, or write Gisholt for literature.

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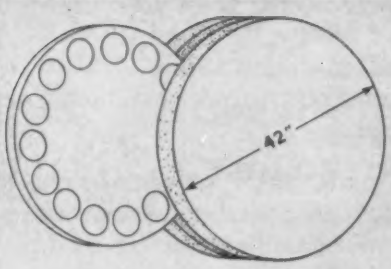

Rotary work carrier is illustrated. 2H40 is also available with thru feed or gun type fixturing.

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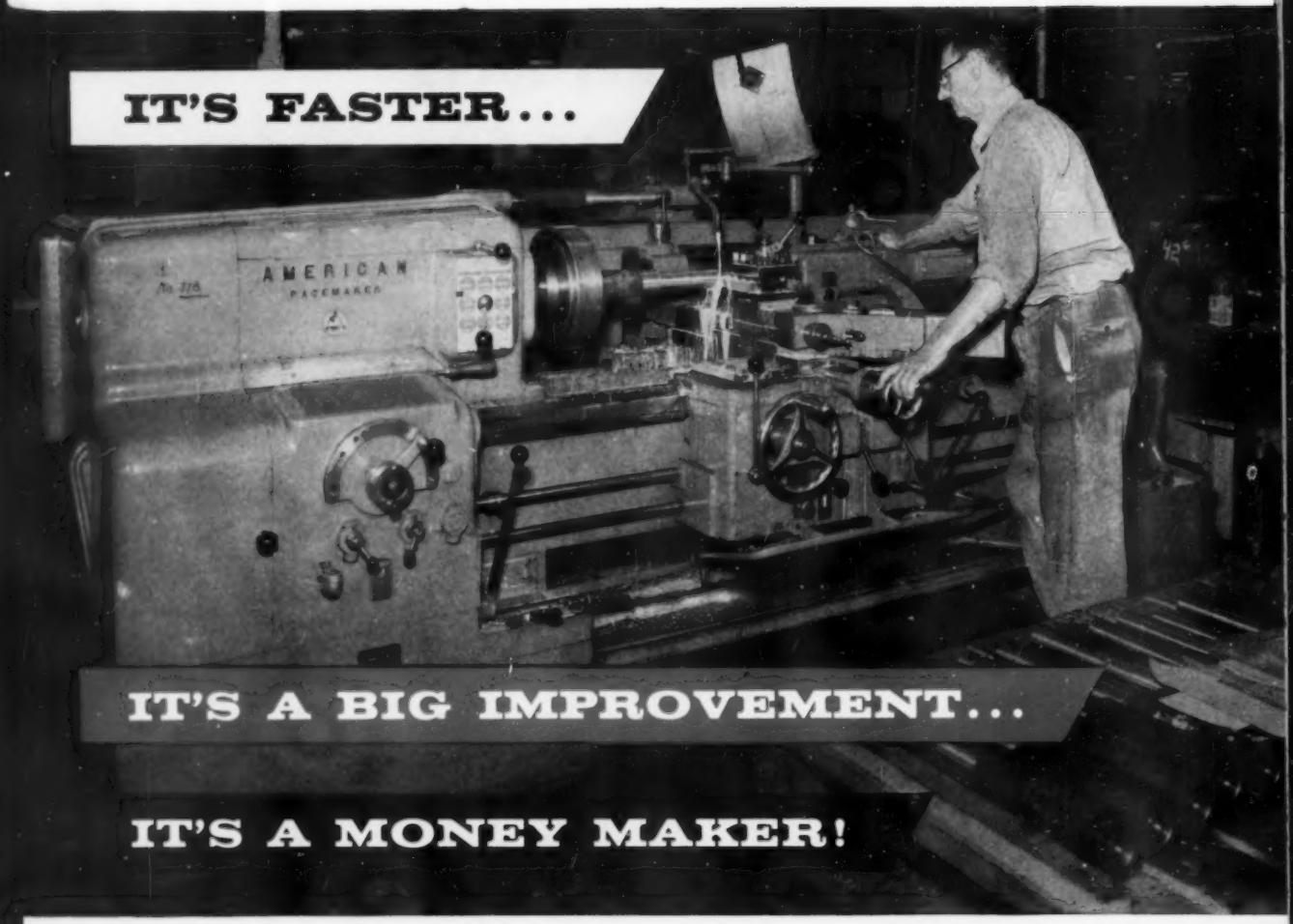

These are exact words from the production officials of The Cleveland Worm and Gear Company, of Cleveland, Ohio, which company produces the universally known and widely used Cleveland Worm Gear Speed Reducers.

The machine to which they refer is their new "AMERICAN" DeLuxe Model Hydraulic Duplicating Lathe. This lathe, as the illustration shows, is used primarily for machining worm forgings from a round template.

Accurate duplication of parts, high speeds, heavy cuts, plenty of power, quick acting air operated tailstock and ease of operation are the major characteristics contributing to the amazing productivity of this machine.

More production per man hour is the answer and only answer to spiraling costs—modern, high production machinery is the answer to greater production per man hour. Judging from reports, The Cleveland Worm and Gear Company has found this to be true.

Bulletin No. 135 gives a complete description and shows many examples. It's yours for the asking.

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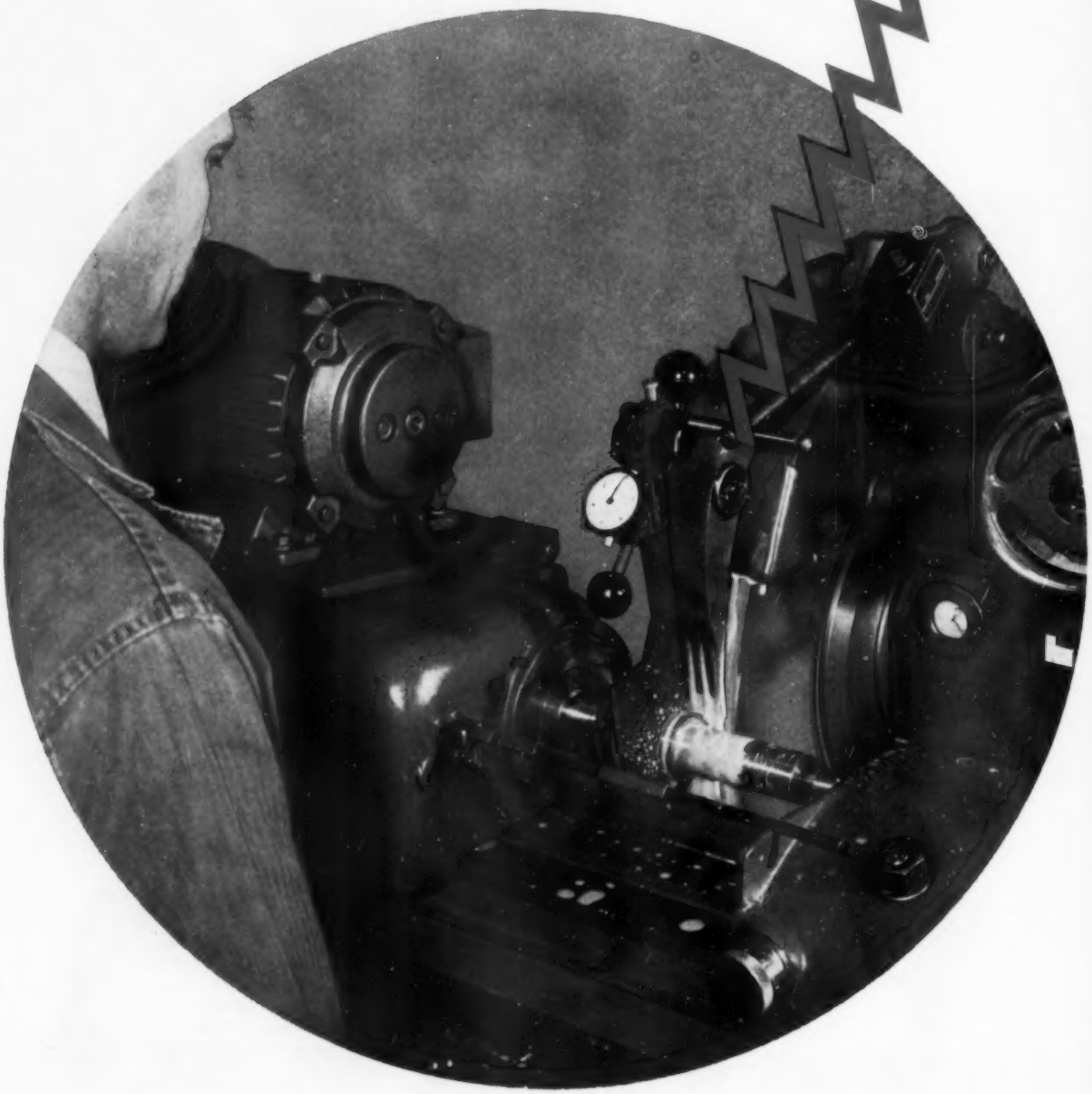

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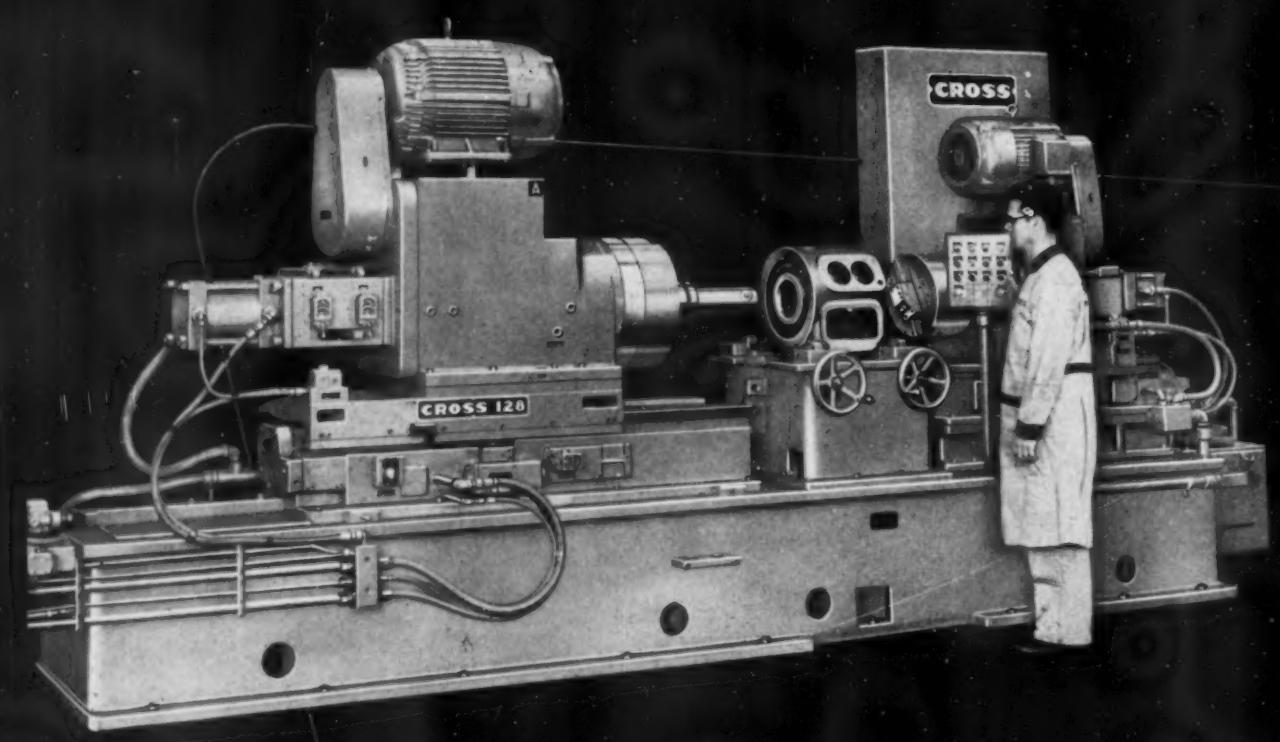

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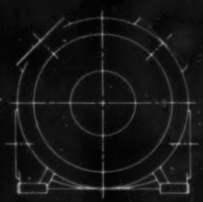

Two-bank compressor for several 4 cylinder models.

Three-bank compressor for several 6 cylinder models.

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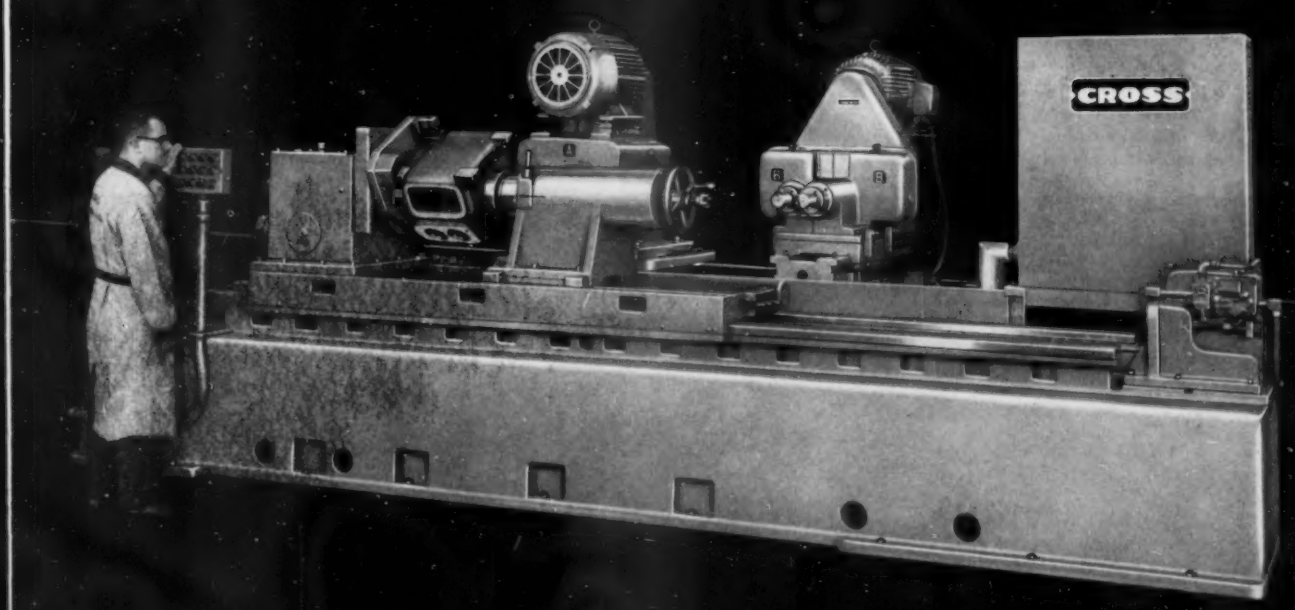

Featuring a high degree of precision, processing versatility and machine flexibility, these two new Cross machines process a complete product mix of 4, 6, 8 and 12-cylinder hermetic compressor housings in lots of 50 each. The two-way boring and facing machine rough and precision finishes crankshaft bores, thrust faces and the motor mounting face. The two-station shuttle-type machine rough and finishes all bank faces and cylinder bores.

Both machines provide completely automatic operations including part indexing and shuttle; incorporate automatic lubrication including new methods of lubricating cross facing heads automatically; and both provide optimum flexibility for handling future part design changes including major dimensional variations in the number, diameter and location of cylinder bores.

Both the two-way and shuttle machine combine rugged dependability for heavy stock removal in roughing with a high degree of accuracy for precision finishing. Critical tolerances are held closely; bank and thrust faces relative to cylinder bores are held square within 001"; main bore and cylinder bore diameters concentric within .001"; motor mounting face and crank bore thrust faces held parallel within .001".

The two-way and shuttle machines are smaller and far less costly than a group of standard machines that would be required to perform identical operations without automated features and advantages.

Both machines incorporate standard Cross "Building Blocks" including wing bases and feed units. All standard and special parts are completely interchangeable for easy servicing.

For details on these—and other automated Cross machines for profitable, low volume production, write, wire or phone:

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How steel tubing saves weight in helicopter...in budget, too

Shown below is the main rotor shaft of a new model helicopter. Because it was hollowed out of solid steel bars to save weight, it was costly to make. After machining to thousandths of an inch accuracy, previously undetected steel flaws showed up. One out of every five parts had to be rejected.

Timken Company Metallurgists were consulted. After careful study, they recommended a special analysis of Timken® seamless steel tubing. Savings began immediately. Because the hole was already there, no drilling was required. Steel was saved. And with the extra advantage of uniform forged quality in Timken seamless tubing, rejects of finished parts were practically nil.

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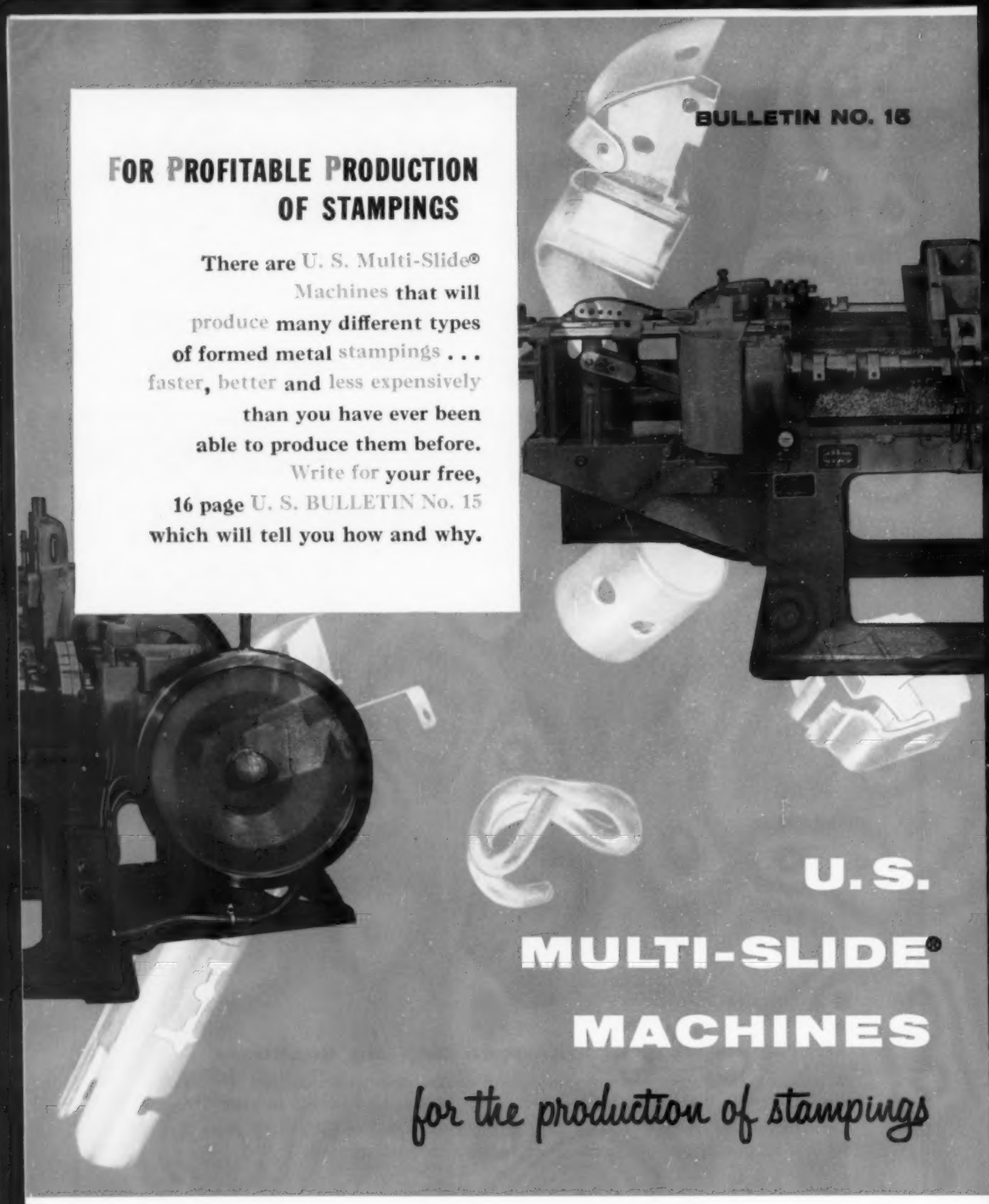
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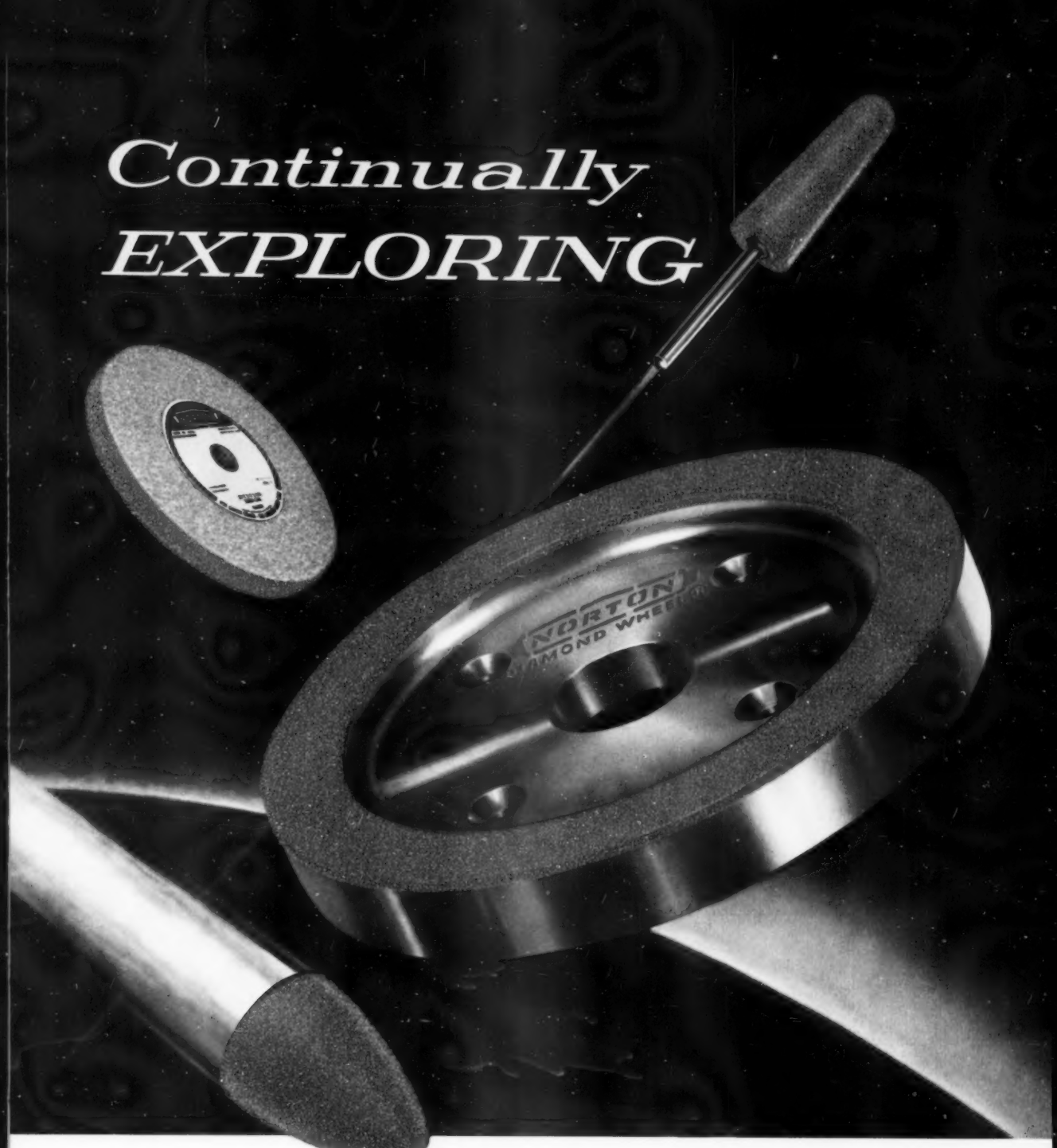

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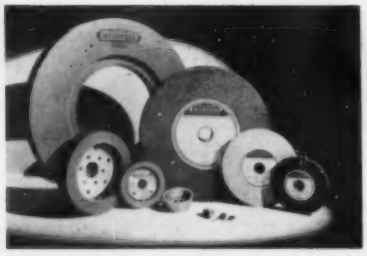

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Great New Discoveries. Over 190 Norton scientists and technicians, in many specialized laboratories, are using the latest equipment for research, development and testing of more efficient, more economical abrasives and abrasive products. Latest discoveries from this center of abrasive progress include 44 ALUNDUM

abrasive, three outstanding grinding wheel bonds—G, K and R50—metal-mounting of mounted wheels, miniature mounted wheels and SD diamond wheels, using man-made diamonds.

Fastest Possible Deliveries. Besides immense factory stocks at Worcester and Santa Clara, California, Norton maintains huge warehouse stocks in five conveniently located cities. And Norton distributors, in 283 cities, keep their stocks fully adequate to meet the needs of their areas. For prompt deliveries — extra fast in emergencies — plus helpful service, your Norton distributor is as near as your phone.

NORTON
ABRASIVES

NORTON COMPANY • WORCESTER, MASS.

District Offices: Atlanta • Chicago* • Cleveland* • Detroit* • Hartford • Los Angeles Area (Huntington Park) Indianapolis • New York Area (Teterboro, N.J.) • Philadelphia* • Pittsburgh* • St. Louis

*Warehouse Facilities and Stocks at this location

BEHR-MANNING CO., Troy, N.Y. is a Division of Norton Company

Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electro-Chemicals — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

8-59

Compare the Production
of these two
DoALL BAND MACHINES

1952 MODEL V36 MACHINE

Obsolete fixed table machines were terrific in their day, using carbon steel blades and manual feed to cut mild steel at a rate of 1.7 sq. in./min.

1959 CONTOUR-MATIC*

Machine hydraulically-powered work table and Demon* H.S.S. saw blade to cut mild steel at 10.1 sq. in./min.

They Look Alike...But *LOOK* at the *DIFFERENCE!*

You'll be amazed at the increased cutting rates, accuracy and finish achieved by new Contour-matic band machines. Here's a typical case:

CONTRACT JOB—splitting high-chrome, high carbon tool steel bushings 13½" O.D. x 8½" I.D. by 31" long. It took 8 hours to split a bushing on the fixed table Model V 36 using carbon steel blade.

FLOOR TO FLOOR TIME CUT 75%—Now the job is put on the power feeding table of a Contour-matic which uses Demon H.S.S. saw blades to split a bushing in just 2 hours. This splitting becomes semiautomatic with accuracy and finish greatly improved. And the tool life is 30 times longer than carbon steel blades.

Yes, there are literally hundreds of other applications where the new Contour-matic can make similar savings over fixed table saws and more expensive machines you are using for shaping cuts, recessing, beveling or cutting contours in the toughest steels. Investigate now to replace obsolete machines that can't keep up with the competitive race for lower costs. Call your local DoALL store for a free demonstration—right in your own plant—or write.

FREE—"Job Spotting" Service

For your evaluation—illustrated case histories of job savings made by Contour-matics over former methods will be mailed to you periodically. Send us your name on company letterhead.

*Reg. T. M. The DoALL Company

B-57

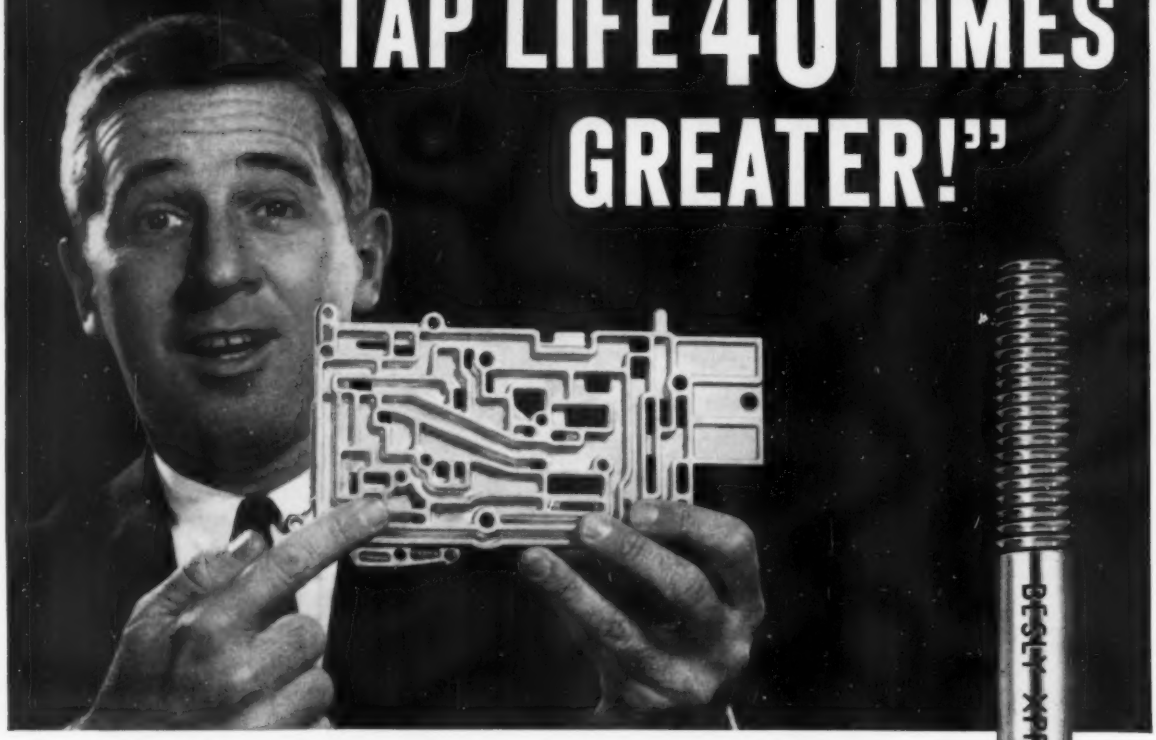
THIS IS A TYPICAL DoALL STORE

The DoALL Company, Des Plaines, Illinois

Call Your DoALL Service-Store

Machines and Blades · Surface Grinders · Power Saws · MACHINE TOOLS · CUTTING TOOLS · MEASURING INSTRUMENTS · SHOP SUPPLIES IN STOCK

"TAP LIFE 40 TIMES GREATER!"

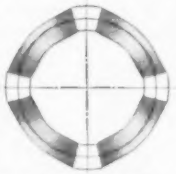


BESLY X-PRESS® TAPS—based on a new cold-forming principle—help boost production and cut downtime. A leading automotive transmission builder used to make this aluminum die cast transmission channel plate at an average rate of 1,000 to 1,500 holes per tap. Eleven 10-24 through holes had to be tapped in each plate. Production was low due to excessive tool breakage and downtime.

When the transmission builder changed to Besly 10-24 B-4 X-Press Taps, they averaged 59,450 holes per tap. Tool life increased 40 to 1. Production went up. Tap breakage, tool costs, and downtime descended sharply.

UNIQUE CAM-RELIEF DESIGN with taper point enables X-Press Taps to excel conventional cutting taps for faster production and longer life. Chips eliminated because the X-Press Tap cold-forms internal threads without cutting. Breakage is less. More pieces are tapped per hour.

Besly X-Press Taps are ideal for either blind or through holes and are recommended for copper, brass, zinc, leaded steels, aluminum, lead, die castings, and other ductile metals.



Cross-section showing unique cam-relief design

Call your Besly distributor or write us today for new booklet containing complete data.

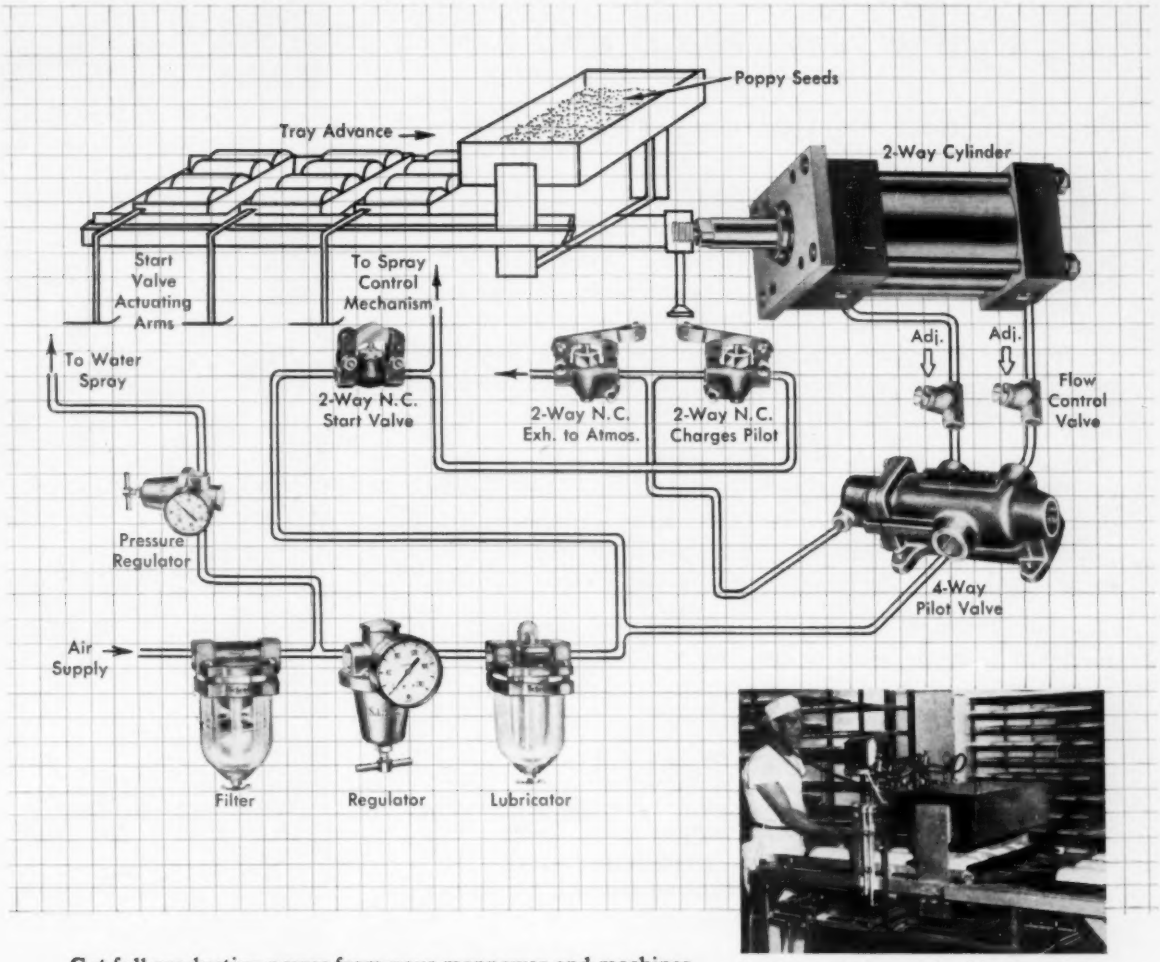
BESLY®

BESLY-WELLES CORPORATION

118 Dearborn Ave., South Beloit, Illinois

Grinders and Abrasives • Taps • X-Press Taps® • Drills • Reamers • End Mills • Tool Bits • Gages • Carbide Tipped Tools, Blanks, Lapped Toss-away Inserts and Holders

PLANT MAKES STANDARD SCHRADER AIR PRODUCTS DO 65% OF THE WORK AUTOMATICALLY



Here's a typical example of how companies can automate with air. The hookup of Schrader Air Products in the large picture was used to perform repetitive operations by General Baking Company, Detroit, Michigan. A tray of loaves moving on a belt trips a Schrader 2-way valve which actuates the water spray mechanism—and starts the 4-way valve-operated reciprocating system. The 4-way valve operates the cylinder which sifts poppy seeds onto each loaf in turn. This was formerly repetitive hand work. Schrader representatives helped plan this effective air system, as they have helped plan innumerable others.

Get full productive power from your manpower and machines, like this company. Simply take advantage of the *air* you already have! Hook up Schrader Air Products to fit your needs and get these benefits:

AIR IS FAST AND ACCURATE: time operations to fractions of seconds, produce at high speed. AIR IS TIRELESS: keeps going when fingers fail. AIR IS ECONOMICAL: saves you time, money and effort. AIR IS SAFE: reduces operator fatigue and machine-fear.

These are benefits every shop needs. Get them all when you automate with Schrader . . . the finest line of Air Cylinders, Valves and Accessories . . . and ideas for cutting your operating costs.

Use the full Schrader line to do your air control selecting. Your Schrader distributor can help you pinpoint what you need. For more data write:

A. SCHRADER'S SON
Division of Scovill Manufacturing Company, Incorporated
462 Vanderbilt Avenue, Brooklyn 38, N. Y.

Schrader®
a division of SCOVILL

QUALITY AIR CONTROL PRODUCTS

UNIVERSAL-CYCLOPS STEEL *Expands*

. . . with a New Plant and New Cold Finishing Facilities at Coshocton, Ohio

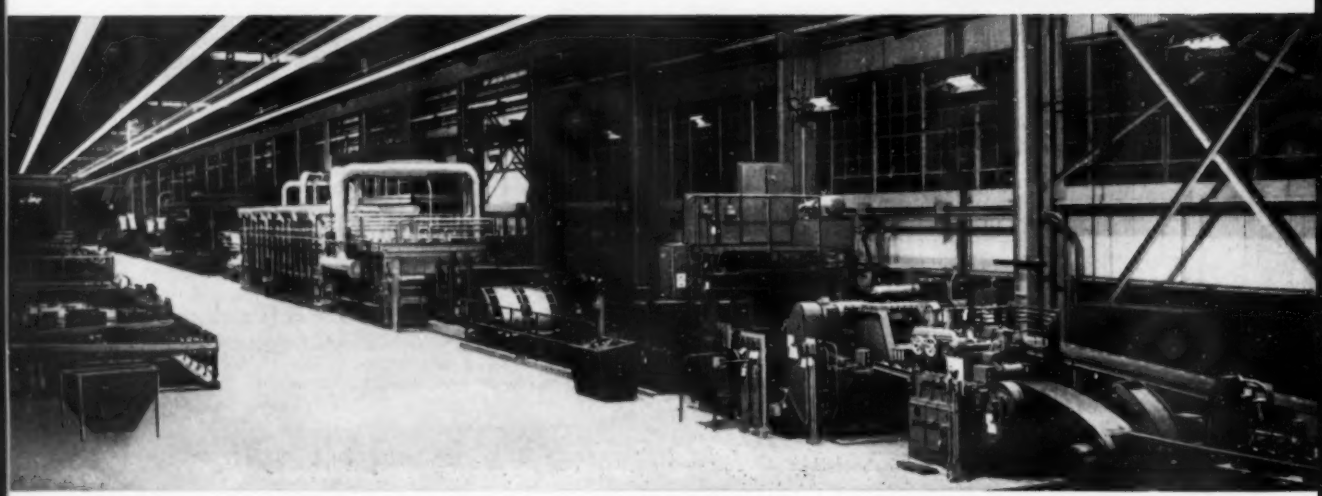
Universal-Cyclops, one of the leading producers of cold rolled stainless steel strip, announces the opening of a new plant at Coshocton, Ohio, which will supplement our facilities at Bridgeville, Pa., and greatly augment production capacity to meet the ever-increasing demands for UNILOY® Stainless Steel.

Completely new, this modern plant represents a major step in our corporate expansion program. It provides the finest facilities, production skills, engineering and metallurgical experience. It conforms to the policies maintained throughout our 75 year history, to constantly strive for highest quality standards in our products.

Customer oriented throughout, personnel and equipment are geared to meet the needs of our customers. Large stocks of finished coils are maintained at all times for prompt delivery.

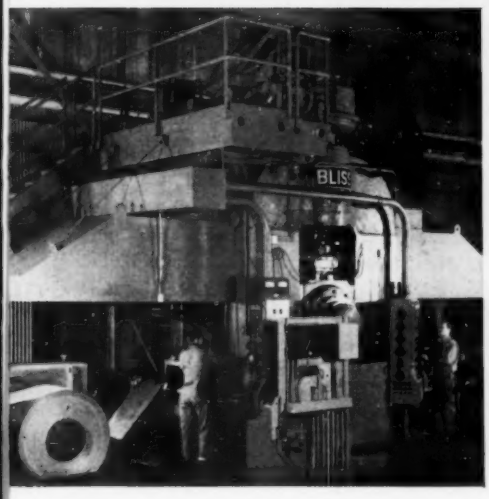
UNIVERSAL CYCLOPS
UC STEEL
STEEL CORPORATION
Bridgeville, Pa.

STAINLESS STEELS
TOOL STEELS • HIGH TEMPERATURE METALS



The most modern annealing and pickling line in the industry—over 600 ft. long. Handles two coils up to 24" width.

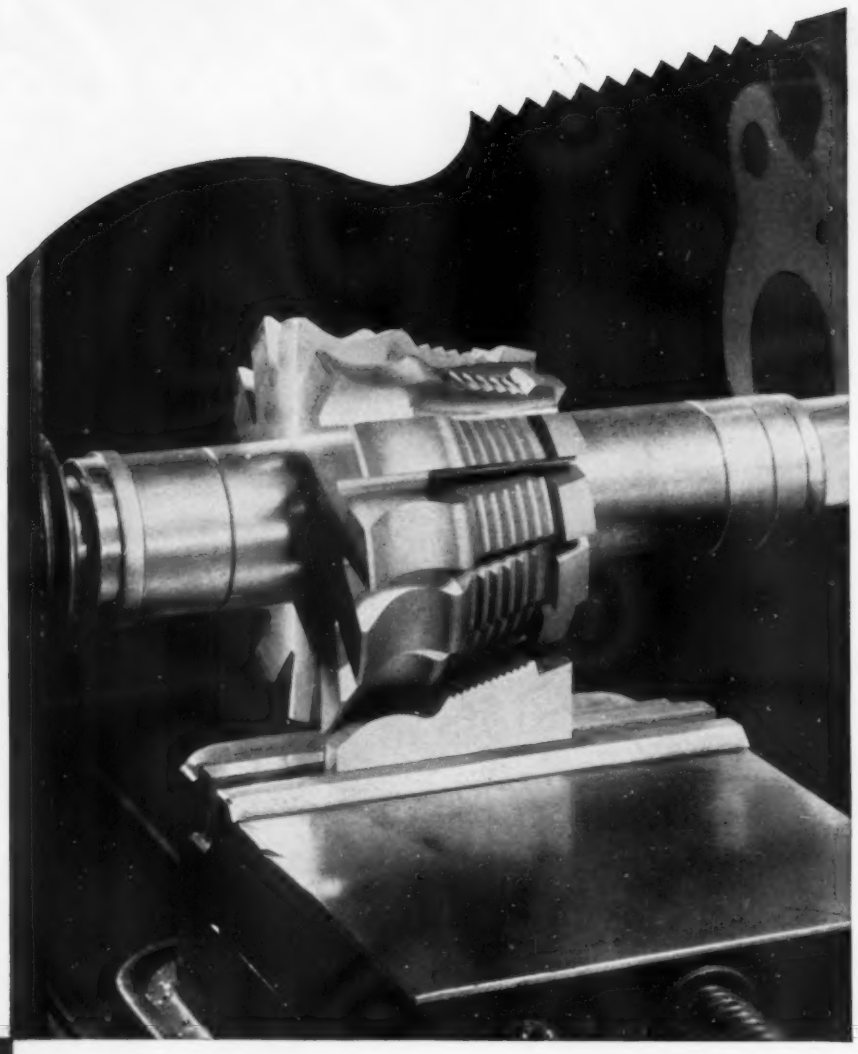
Stainless Strip Capacity



Modern four-high cold rolling mill.

Temper mill provides top quality finish.

Large stocks of stainless steel coils—assure prompt delivery.



Cutters with built-in Efficiency and Accuracy

This is an example of how efficiency and accuracy can be designed right into the cutting tool. The manufacturing and engineering capabilities of Barber-Colman Company can be added to your own in finding better solutions to milling problems.

The form shown at the left of the part is milled at the same time the multiple serrations are cut. Milling sharp points on the serrations is made possible by the alternate tooth design (see photo, above). The cutter is shown milling a sample which is later projected against an enlarged layout of the part to assure that the cutter will produce within specified tolerances. But, some of the most important quality features of this cutter are not visible to the naked eye.

Unground form . . .

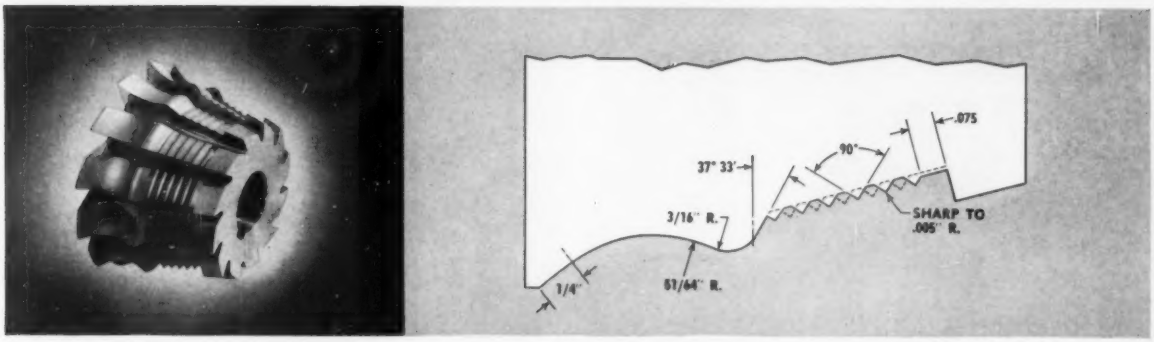
Ability to combine complex tool geometry and accuracy in this cutter without form grinding reduces original cost. In addition to greater accuracy, you get longer tool life from a cutter that is metallurgically as well as geometrically well formed. Barber-Colman's individual processing in the most modern metallurgical lab and heat-treating department assures highest quality which can be tested by the number of high-quality parts manufactured for every dollar of cost.

Sharpening economies . . .

Additional savings result from Barber-Colman's exclusive design and manufacturing techniques. For example,

Mill Odd Shapes in One Operation

...with Barber-Colman Form-Relieved Cutters



the smooth finish on the tops and sides of the teeth eliminates rough edges — a common cause of breakdown on the flanks. Faces are index-sharpened, permitting the important economy of *automatic resharpening.* Your sharpening guide or an automatic sharpener will maintain original accuracy throughout the life of the cutter.

These economies reduce the most important elements of tool cost: the cost of scrap and rework, cost of sharpening, cost of downtime for tool changes, and cost of tool depreciation.

Five types of engineering...

You get more than a cutting tool when you buy "Barber-Colman." You get five types of specialized engineering that reduce your costs and upgrade your quality:

1. *Application engineering* — on-the-spot evaluation of milling problems by experienced tool designers.
2. *Design engineering* — highly specialized tool engineering, backed by electronic computer facilities for fast, accurate calculation of complex forms.
3. *Metallurgical engineering* — specially selected steels and heat treatment for your particular material and tool geometry.
4. *Manufacturing* — the most complete and advanced processes under one roof for producing exactly the right finish, highest accuracy, and *any* cutter style.
5. *Quality control* — optical master inspection, seven different control stations, and numerous separate inspections for individual cutters.

Whether you want to combine operations, change processes, or just get more out of your tooling dollar, you can have a Barber-Colman field engineer at your desk for consultation by just calling Rockford — TR 7-5741.

Barber-Colman Company

BARBER COLMAN

83 Loomis Street, Rockford, Illinois

KEARNEY & TRECKER *builds production*

MACHINE TOOLS FOR EVERY INDUSTRY

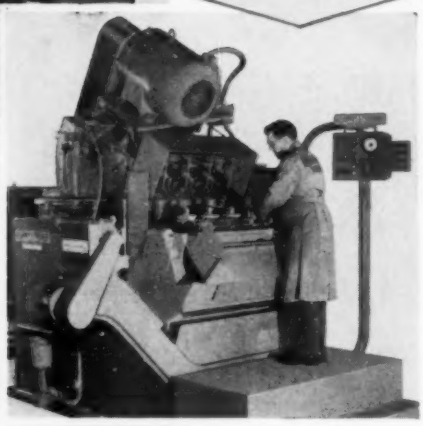
Since 1898 . . . Kearney & Trecker Customer Engineering Service — supported by an outstanding staff of engineers experienced in production milling machine design and application — combined with the finest and latest machine tools in an ultra modern plant is always ready to solve your production problems.

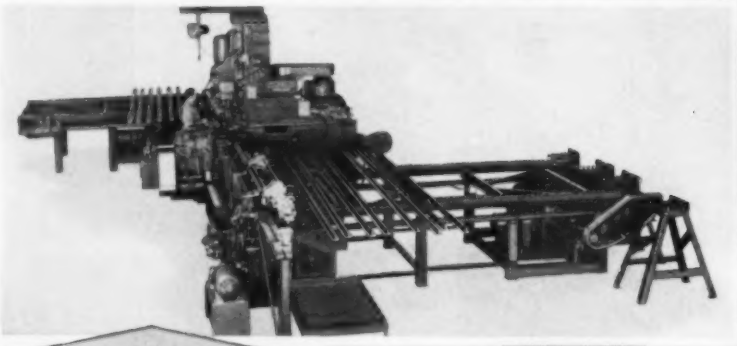
Oil Industry

automatic 4-spindle milling machine mills 4 rock bit cones *simultaneously*... in a trunnion-type fixture having 4 work-piece spindles. PRODUCTION — a constant flow of this expendable type tool to meet the steady demand.

Automotive Industry

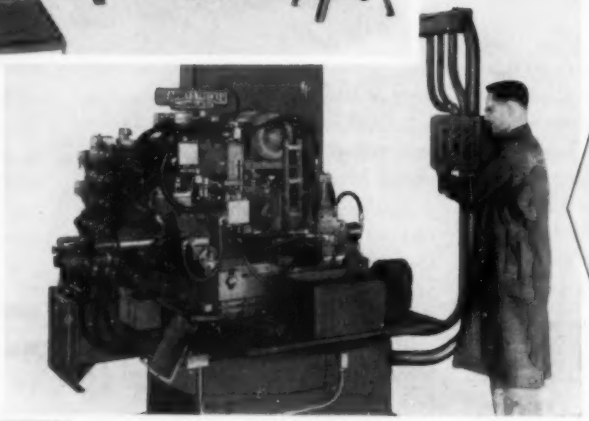
this 88 spindle, 3 vertical head machine performs drilling, chamfering, counterboring, trepanning, spot-facing, reaming and tapping operation on a differention case and cover. PRODUCTION — 67 cases, 67 covers per hour.





Elevator Industry

12 spindle automatic transfer machine mills mating tongue and groove on ends of elevator guide rail-drills mounting holes in rail flanges—for continuous rail mounting. PRODUCTION—28 completely machined rails per hour—180% increase over old method.



Tool Industry

Flutes and shank squares are milled on tap blanks by this automatic machine. Tap blanks are hopper loaded and automatically unloaded. RESULT—greatly increased hourly production.

KEARNEY & TRECKER MILWAUKEE ®

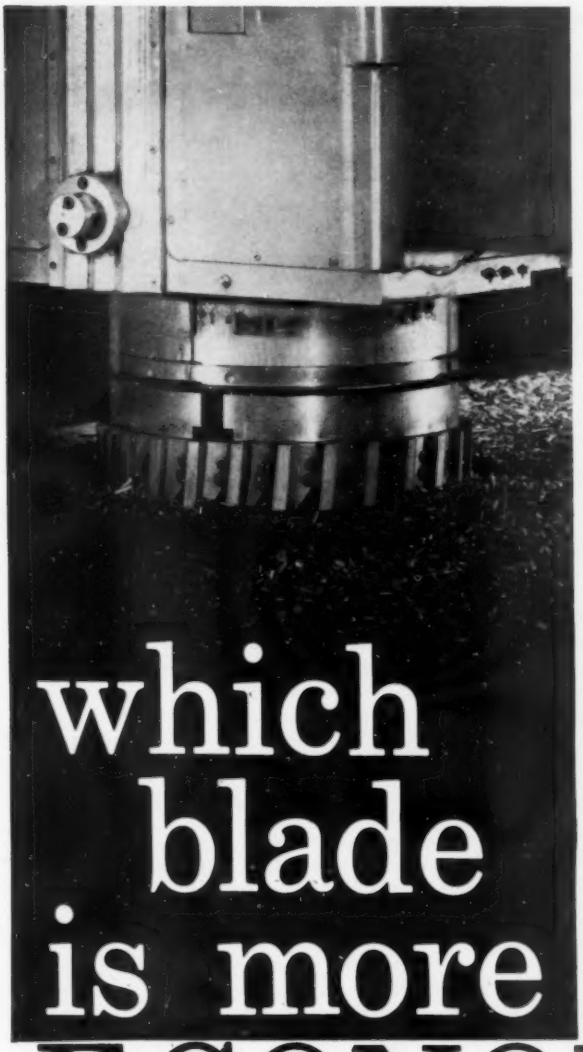
Write for bulletin SMD-57 on your company letterhead.

KEARNEY & TRECKER CORPORATION

Special Machinery Division

6772 W. National Avenue • Milwaukee 14, Wisconsin

high speed steel or carbide...



which blade is more ECONOMICAL?

Even in the most ordinary milling and boring work, fields of application have a habit of overlapping. And, as a result, choice of the most economical and efficient blade material can often be a challenging problem.

Solutions to machining problems like these are our primary product. You don't buy Ingersoll cutters, as such—or high speed steel or carbide blades. What you buy is lower operating costs and improved finish. You buy increased productivity!

Only after a thorough study of your machine, work piece, depth of cut, speed, feed rates and finish requirements do we recommend any cutter. And we assume full responsibility for every recommendation we make.

We would welcome the opportunity to tell you more about this unique cutter selection service. Write:

This helpful new booklet tells you how to reduce the cost of chips and improve your milling and boring performance. Ask for a free copy of booklet No. 68F.

THE
INGERSOLL
MILLING MACHINE COMPANY
CUTTER DIVISION
505 FULTON AVENUE • ROCKFORD, ILLINOIS

USE READER SERVICE CARD, CIRCLE 20

Now available on all Parker-Hannifin

STRAIGHT THREADS FOR LEAK-PROOF

Industry's new standard as published in J. I. C. Recommendations (April, 1959) and S. A. E. Standards (1959 Handbook)

Why accept less?

Parker-Hannifin now offers a new standard *at no extra charge*—high-pressure hydraulic components with straight thread port connections* for O-ring type fittings. This new standard—assuring a leak-proof and drip-free seal—is the most logical engineering approach to the problem of hydraulic circuit connections. The Joint Industry Conference Recommendations now state:

"Fittings that incorporate separate synthetic or metal-to-metal seals, or seal with pressure *should* be equipped with Unified National Fine (UNF) straight thread port connections."

And the Society of Automotive Engineers' 1959 Handbook states:

"The S.A.E. straight thread 'O'-ring boss is the preferred port for use in hydraulic devices."

Both support this new standard—and the U. S. Navy Bureau of Ships in MS16142 (SHIPS) has adopted the S.A.E. Straight Thread Boss Design as their straight thread standard for use in hydraulic and air systems in Naval ships. Such extensive support is understandable. The Parker-Hannifin straight thread port connections combine a built-in pressure sealing device with a rigid mechanical connection. This contrasts with the loose connection of a "backed-off" pipe thread and a relatively weak auxiliary sealing device.

Straight thread fittings and port connections are not a proprietary product or design. Although developed by Parker-Hannifin, they were immediately made available to the fluid power industry on a completely open basis.

They have been thoroughly field tested. In the severe service on mobile hydraulic equipment, today more than 6 out of 10 of the port connections are of the straight-thread type.

Now machinery builders and users alike are turning to this proved method of port sealing. Pipe threads for high-pressure hydraulic applications are fast becoming obsolete as more and more leading manufacturers recognize these advantages of straight threads in their production equipment:

No more wedging action with resulting distortion and breakage due to over-tightening . . .

No more messy pipe dope and the danger that it will infiltrate the hydraulic system . . .

No more leaks because of temperature changes or high shock conditions . . .

No more failures of costly auxiliary seals due to weak, imperfect threads that fit on thread run-out.

Why accept less? Next time you order high-pressure hydraulic components, specify Parker-Hannifin with straight thread port connections and fittings . . . you'll get leak-proof sealing—industry's recommended standard.

**Mobile equipment spool type control valves are all supplied with straight threads. Other components are still available with dry-seal pipe threads.*

HANNIFIN COMPANY
545 S. Wolf Road, Des Plaines, Illinois

Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

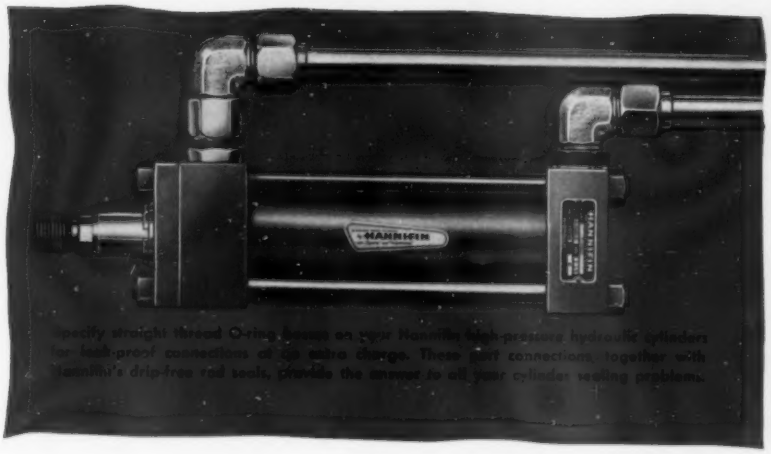
Parker SEAL COMPANY
10567 Jefferson Blvd., Culver City, California

Parker HYDRAULICS DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

4 DIVISIONS OF PARKER-HANNIFIN CORPORATION

high-pressure hydraulic components

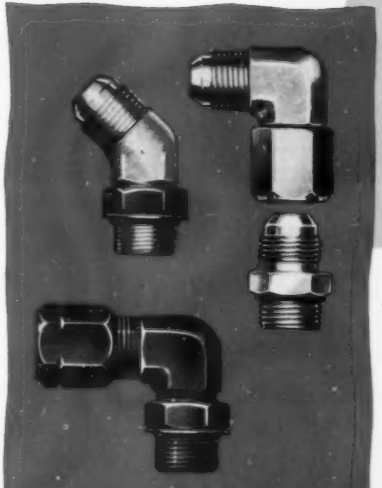
PORT CONNECTIONS...



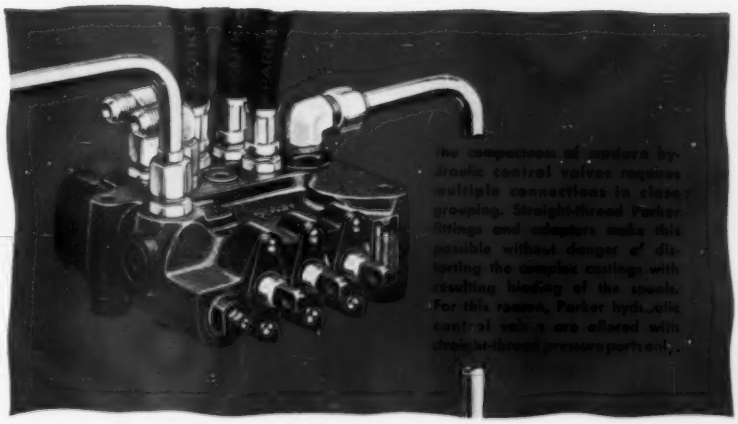
Specify straight thread O-ring fittings on your Hannifin high-pressure hydraulic cylinders for leak-proof connections at no extra charge. These port connections, together with Hannifin's drip-free rod seals, provide the answer to all your cylinder sealing problems.

Both Parker's new "Krimp-lok" permanent-end hose assemblies and "Hoze-lok" reusable fittings (as well as all adapters) are available with straight threads. O-ring sealed for any specified fluid.

The O-rings used in Parker port connections are made only from service-tested Parker Seal Company compounds. With an ever-increasing number of fire-resistant fluids now on the market, it pays to avoid "jack-of-all-fluids" seals and stay with the Parker Seal compound specifically made for the fluid you will be using.



There's a complete line of Parker straight thread O-ring fittings and adapters for you to choose from . . . Triple-lok (flare type) and Ferulok® (flareless, bite type). Either method assures you leak-proof, trouble-free hydraulic connections.



The compactness of modern hydraulic control valves requires multiple connections in close grouping. Straight-thread Parker fittings and adapters make this possible without danger of distorting the complex castings with resulting binding of the spools. For this reason, Parker hydraulic control valves are offered with straight-thread pressure ports only.

JONES & LAMSON TURRET LATHES

the man who needs a new machine tool is already paying for it

Single point threading to a finish of 15-20 RMS is completely automatic–and fast

The I. D. of these large cap-nuts is approximately 5¼″. The material is High Chrome Nickel Steel, Rockwell C 30–32. The thread is 8 pitch, 5½″ long, *and tapered .005″ per inch.*

It's a tough job to make time on, but a J & L Turret Lathe equipped with an Auto-Threader, does the threading in 5 minutes!

Here's how: The part is faced and a rectifying bore is made; in the same chucking, threading is completed in 16 automatically-controlled passes, with a graduated cutting depth for each pass. *Pitch diameter is held to .002″*, and finish is 15–20 RMS on the flanks.

On the old machine, milling the thread alone took 75 minutes. With this new setup, the entire operation — including loading, facing, boring, threading and unloading — is only 15 minutes.

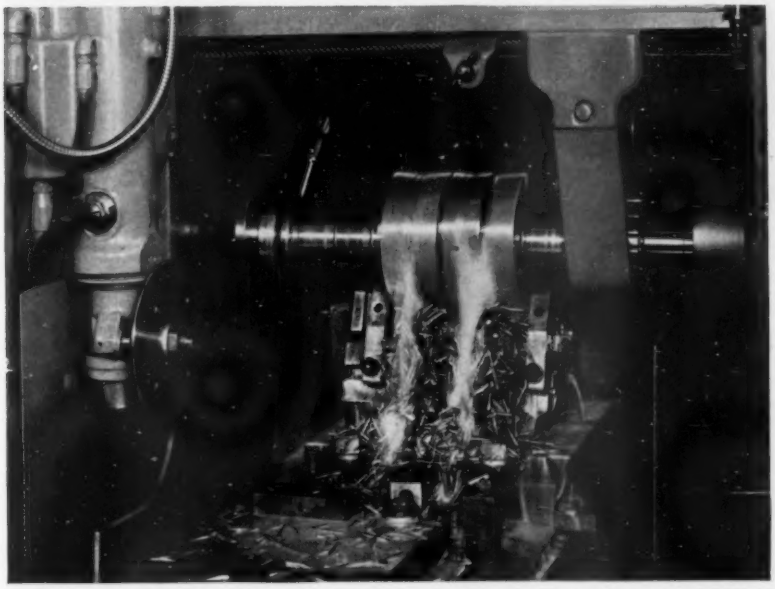
Jones & Lamson Turret Lathes are available with: Completely automatic controls; 45°, 60°, and 180° Tracers; taper attachments, and a variety of other tooling complements, all designed to increase productivity.

Write for detailed information, Jones & Lamson Machine Company, 518 Clinton Street, Springfield, Vermont.

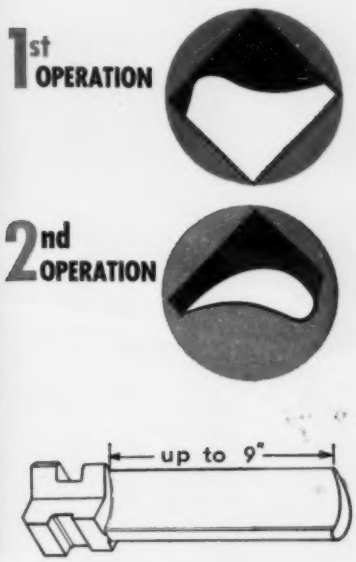
Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

Cincinnati TRACER CONTROLLED HyPowermatic

---mills airfoil section of turbine blades in two operations



Tracer control mechanism (left in the illustration), built-in automatic backlash eliminator, and automatic deflection compensator for the overarm are prominent feature-advantages in this HyPowermatic setup . . . down-milling the airfoil section of turbine blades; up to 9" length of blade in one cut.

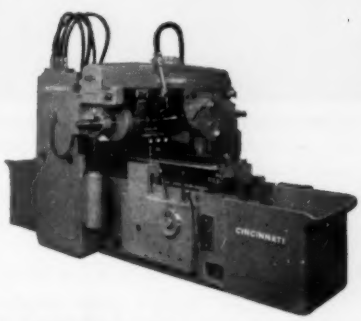


Airfoil sections of steam turbine blades are not the easiest shapes to machine. They present two unusual problems: 1) the turbine blade contour must be accurately reproduced, and 2) length and structural strength of the section impose unique requirements on the machine performing the operation. Both problems disappear when the work is assigned to a CINCINNATI Tracer Controlled HyPowermatic Milling Machine.

Contour and entire length of the airfoil section are milled in only two operations

HyPowermatics offer many advantages for heavy duty work. These fine milling machines are powerfully constructed to remove metal rapidly and smoothly. The tracer control mechanism operates from inexpensive templates attached to the machine table or work fixture. It will accurately trace curves and straight lines up to 80° from the horizontal. HyPowermatics are equipped with an automatic backlash eliminating device which extends the range of work assignments to include down-milling. The Dynapoise overarm, another of the many exclusive features, incorporates an automatic hydraulic deflection compensator.

Other feature-advantages include automatic spindle stop; automatic two-way table cycles; four-position directional table control lever; hydraulic engagement of spindle drive clutch, and many more. May we give you complete information?



CINCINNATI No. 430-184 Tracer Controlled Hypowermatic Milling Machine.
Catalog No. M-1909-1.

The HyPowermatic Family
Two types: 1) for conventional milling operations; 2) for tracer controlled milling operations. Plain and duplex styles. 42 sizes of each. Table travel 36" to 168". 7½ hp to 50 hp spindle drive. Sixteen spindle speeds 40 to 1 ratio. Infinite number of table feeds.

The Cincinnati Milling Machine Co., Cincinnati 9, Ohio

KNEE TYPE AND BED TYPE MILLING MACHINES • DIE SINKING MACHINES
• CUTTER AND TOOL GRINDERS • ELECTRICAL DISCHARGE MACHINES

CINCINNATI®
MILLING MACHINE DIVISION

DOW | MAGNESIUM PRODUCTS

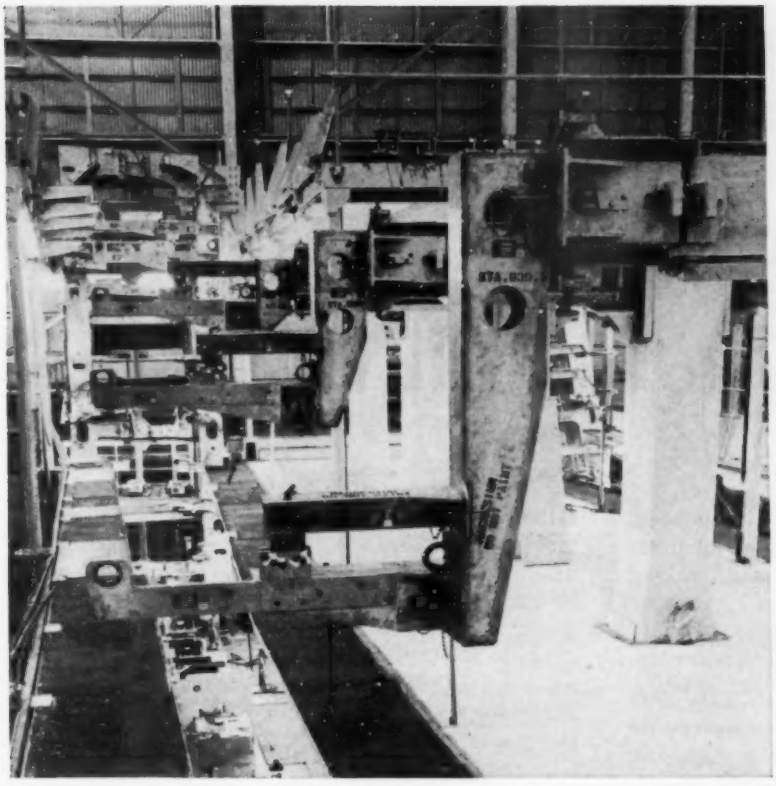
NEW BOEING 707 is first JET to fly in commercial service in the U. S. Extensive use is made of magnesium tooling plate in building the 707.

LIGHTER, FLATTER MAGNESIUM TOOLING PLATE

helps build new jet airliner

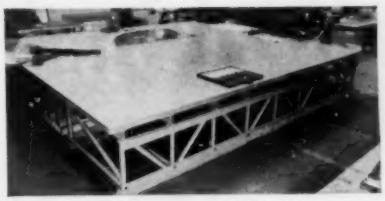
The use of magnesium tooling plate increases rapidly as more and more plants discover its important benefits. Weight savings, precision flatness, fast machining and dimensional stability are reasons for its use in many applications. Take Boeing, for example . . .

Magnesium tooling plate and extruded channels are in widespread use at Boeing's Renton, Washington, plant where the new 707 jet airliner is manufactured. Welded magnesium plate and channel are used as parts for an overhanging wing jig (see photo). Because of magnesium's lightness, such locators can be long and yet be rigid. Furthermore this lightness results in a less



severe load on the basic structure permitting it also to be lighter and less expensive. Other magnesium jigs which can be positioned and put in place by hand can easily be positioned without mechanical equipment. If made of steel, a sizable working party or a crane would be needed each time they were moved.

The top of a 20′ x 20′ master template table at Boeing was constructed of two thicknesses of 1½″ magnesium plate. No machining was required on the plates, permitting a substantial cost savings over a previous master template table made of steel plate, which required considerable machining. The stability of magnesium has maintained the necessary tolerances during use. A large 707 door locating jig also made of magnesium tooling plate can be handled by two men, and can be easily stored when not in use. The stability of welded magnesium structures in this and other applications is invaluable for large assembly jigs.



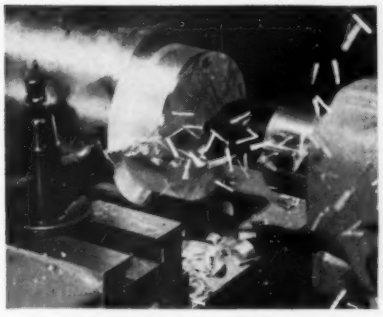
* * *

The lightness, flatness, stability and stiffness of magnesium tooling plate have likewise greatly increased its use as a base plate for plaster forms.

There are other advantages that make lightweight magnesium desirable as tooling plate material: Manually positioned welding jigs are easier to handle, weld spatter doesn't stick, high heat conductivity prevents warping from local heating, and nonmagnetic magnesium used for spot welding jigs causes no interference. Wherever magnesium tooling plate is used, it means less frequent use of lift trucks and other power handling equipment.

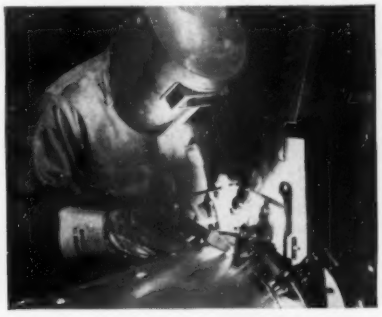
* * *

NEW MAGNESIUM TOOLING PLATE MANUAL. This handy, fact-filled reference book covers shop working characteristics, properties, design, etc., for magnesium tooling plate and tubing. For your copy, contact any Dow sales office or write to Magnesium Products Sales, THE DOW CHEMICAL COMPANY, Midland, Michigan, Department 1339FJ8.



MACHINING TIME CUT TO SHREDS

Drilling, milling, reaming, sawing and other machining operations can be performed on magnesium with surprising economy. Magnesium machines faster and easier, reducing production time and tool wear to a minimum.



LONG SUIT: WELD STRENGTH

Magnesium tooling plate is easily joined by inert gas arc welding. High strength welds and joint efficiencies up to 95% are common. Any joint commonly welded with steel can be welded with magnesium, allowing exceptional versatility for tooling jobs. Magnesium can also be joined by common methods of mechanical fastening.

MAGNESIUM TOOLING PLATE IS AVAILABLE FROM STOCK AT:

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St. Louis 3, Mo.; Kansas City, Mo.; Marietta, Ga.

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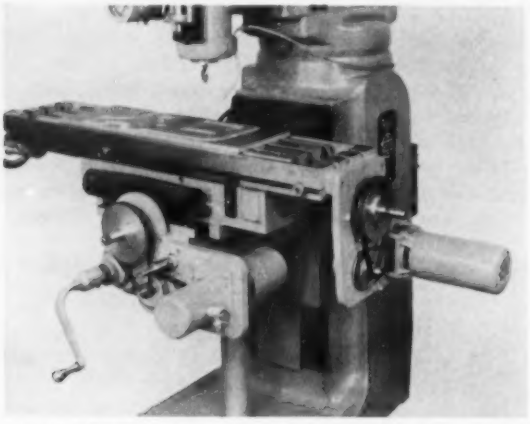
Automation System that LISTENS to MAGNETIC TAPE

Micro-Path is a low-cost 3-axis control system for automating machine tools, industrial processes and similar screw, rack or shaft-driven equipment. It utilizes magnetic tape, operating on the record-playback principle, answering all commands as recorded with unerring accuracy.

LOW-COST—Micro-Path costs as little as ⅛ that of comparable systems. It requires no expensive computers, no mathematics; needs no director of operations, costly staff of technicians nor special programming department.



Illustrating simplicity of attaching Pulservo units to existing machines (guards removed). Three Pulservo units supply all horizontal and vertical feeds.

SIMPLE PROGRAMMING—On machine tool installations, such as illustrated, any skilled machinist can prepare his own program merely by recording a complete machining operation. Direct reading scales and other special controls simplify the task of staying "on blueprint" during the recording cycle. Playback of this tape accurately repeats the operation, duplicating the part. Programming may be carried on either at the controlled machine or at a different location with a special recording table. The magnetic tapes thus produced may be used on any similar machine to duplicate the part.

HIGH ACCURACY—On typical machining operations parts can be held to ±.001" of the drawing specifications with part-to-part repeatability within .00025". In many instances, economies can be shown when as few as 3 parts are machined.

EASILY ADAPTS TO EXISTING EQUIPMENT—With its modular unit construction Micro-Path is relatively easy to install on your present equipment, converting it to fully automatic operation with phenomenal increases in productivity, economy and freedom from human error. It is readily adaptable to milling machines, lathes, vertical boring mills, and other industrial equipment or process controls operated by shaft rotation.

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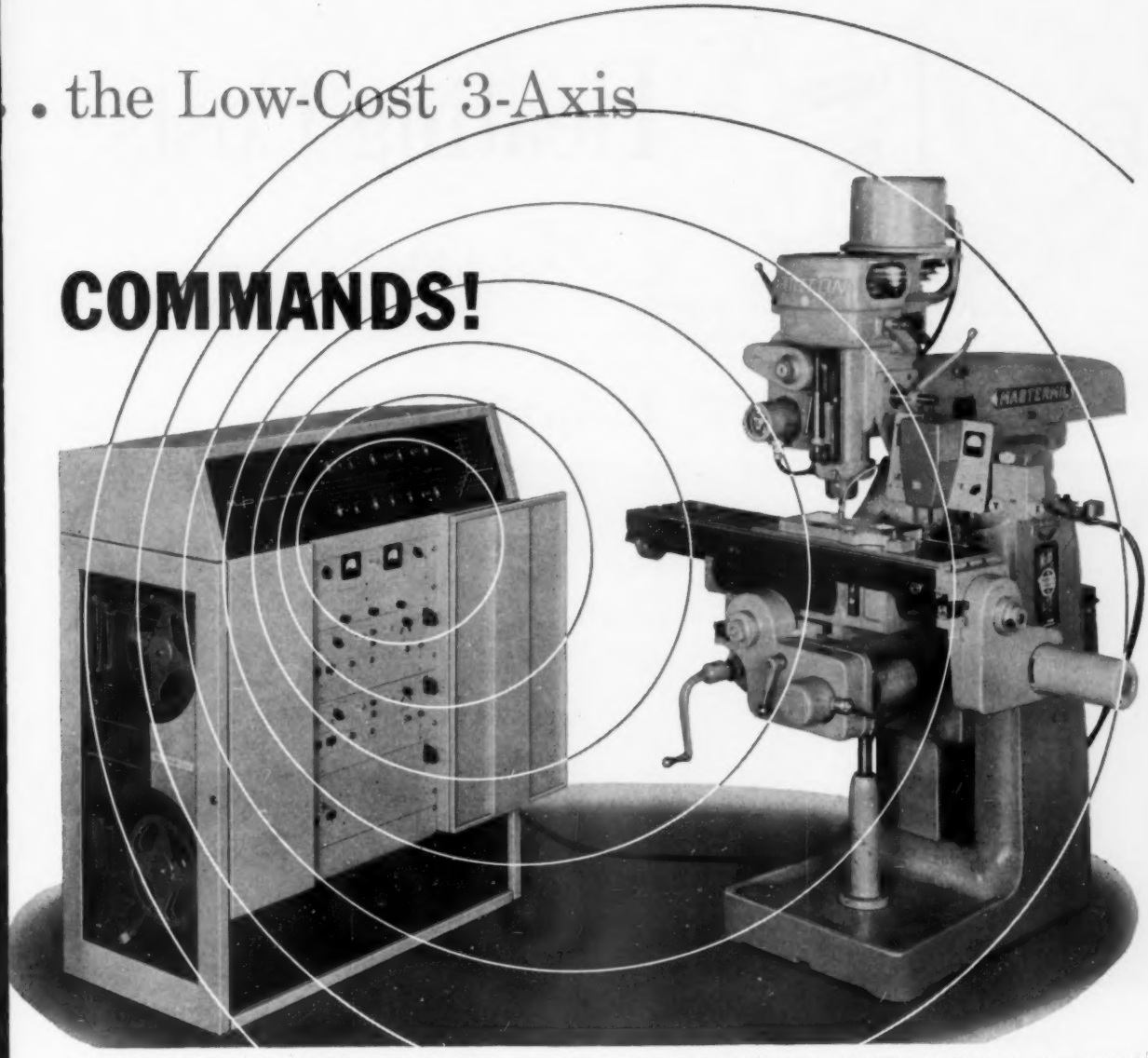
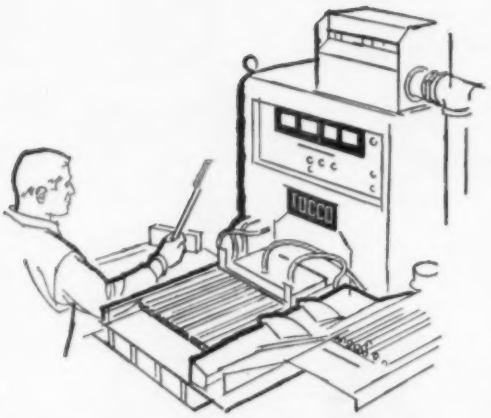


TYPICAL MICRO-PATH FEATURES

- Stylus recording control permits fast, direct programming.
- Adjustable, automatic electronic backlash removal ideally adapts Micro-Path to retrofit applications.
- Fully variable feed rate control permits optimum cutter loading for every operation.
- Programming is easily accomplished from over-size drawings.
- Electronic scale factor reduces recording errors.
- Programming at ¼ playback speed allows longer reflex and coordination time.
- An unlimited number of program functions are possible, such as spindle on-off, automatic clamping, coolant on-off, etc.
- Automatic program checking can be recorded in as many points as desired.
- Closed loop pulse-servo system insures complete accuracy in executing all commands.
- Extreme reliability of our design using simultaneous dual track recording of each motion command assures pulse response of 1 part in 1 billion—equivalent to .001" error in 15 miles of table travel!



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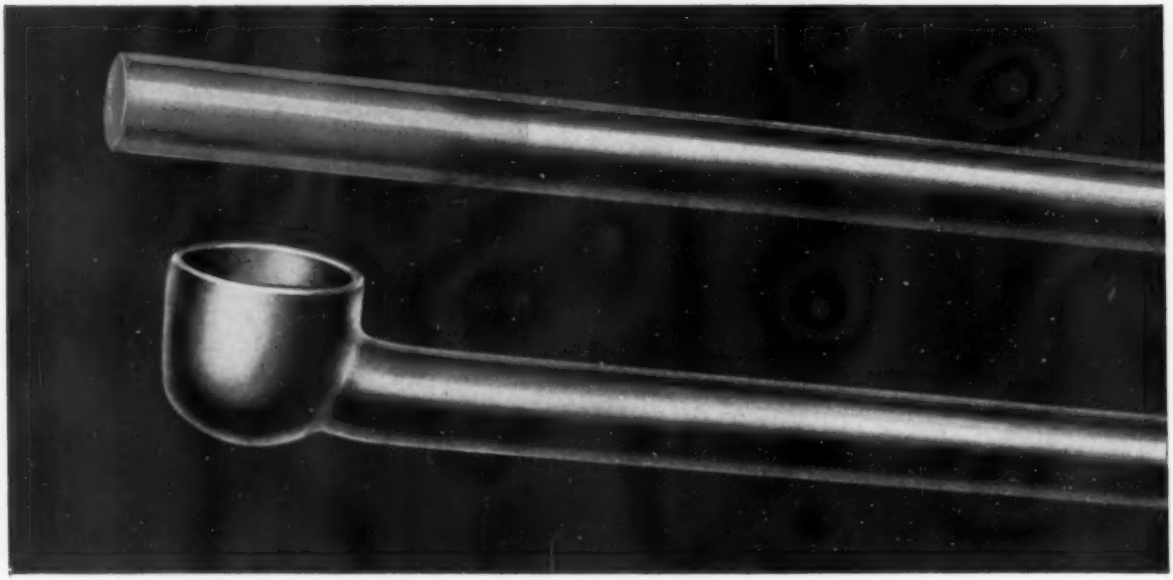
with TOCCO* *Induction Heating*



Engineers at Thompson Products Inc.'s Michigan Division recently changed from gas-fired furnaces to fully automatic TOCCO. Application: heating for forging of automotive tie rods. Result: a substantial reduction in direct labor costs, saving thousands of dollars a year on this heating for forging operation. *Annual savings actually amortize the cost of the TOCCO installation in about one year.*

The automotive tie rod shown here is only one of over 500 parts heated for forging in Thompson's new, modern forge plant. *Every one of these parts is heated with TOCCO equipment.*

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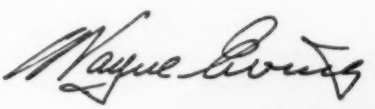

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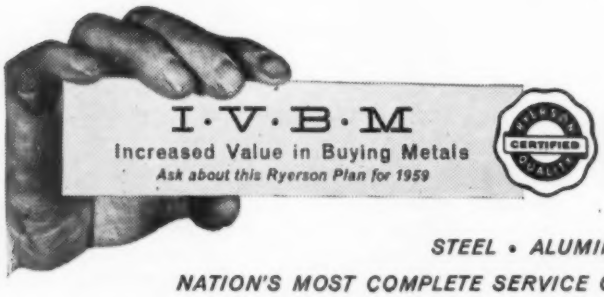

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planning JOB SHOP automation

By T. W. Black
Senior Associate Editor

Fig. 1. Tape-controlled milling machine for turbine buckets. Rollers support the work during machining.

Versatile special machines, numerical control and efficient tooling help to keep production costs down at the General Electric large steam turbine-generator department. While some of the component parts for generators weigh several hundred tons, the basic planning concepts of GE engineers are applicable to virtually all types of parts and all plants.

SPEED, ACCURACY AND RELIABILITY are a desirable combination for all manufacturing operations. Until recently, however, high speed of manufacturing has been associated with long production runs. Today, with the advent of numerical controls and more versatile machine tools, pushbutton production has been brought within the reach of that portion of American industry that produces in lots of 25 or less. Since it has been estimated that 75 percent of American industry falls into this category, a revolutionary improvement in national productivity is under way.

Operations at General Electric's large steam turbine-generator department highlight the problems of the small-lot producer and show how they can be solved by modern tooling. Housed in a 23-acre manufacturing facility, the department has been called the world's largest job shop. Nearly all of the work at this department is in small lots and special designs, many of which are never repeated. Some 1300 different machine tools are used for the production of more than 5000 different turbine-generator components.

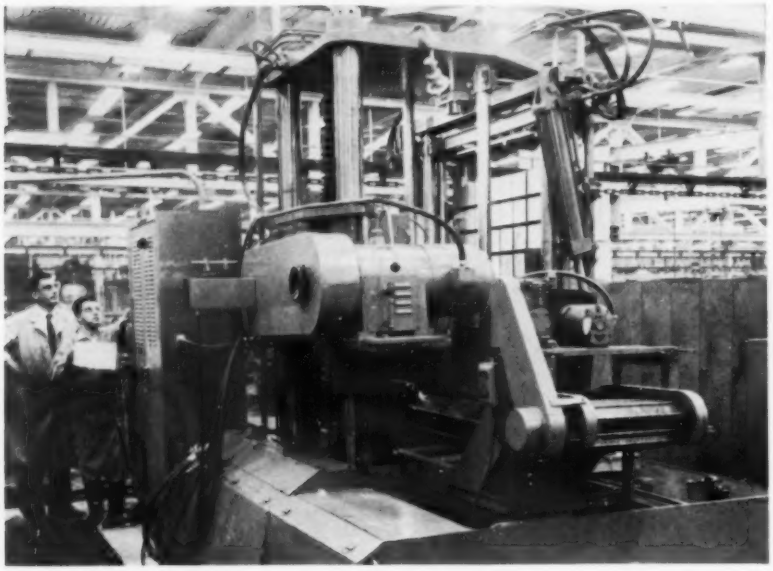


Fig. 2. Tape-controlled single-spindle drilling machine. Control unit is at left. Machine table is in vertical position for drilling. Conveyor removes chips from machining area.

Predictions that needs for electric power will double within the next few years have created a need for much greater productive capacity in the department. This need has been filled in two ways: first through the addition of floor space to allow room for more machines; and second by replacing older machines with new machines that are inherently more productive than their predecessors. Thus it has been possible, in many cases, to reduce the number of machines required to produce a given quantity of a given component, with consequent savings in floor space and manpower.

Numerical Control

The concept of "flexible automation"—made possible through numerical control—has been widely applied in the plant. This has greatly improved speed, accuracy and reliability; has reduced fixture costs; and has trimmed lead time between the completion of engineering drawings and production.

Turbine Buckets: Machining of turbine buckets is an outstanding example of the benefits of numerical control. A turbine bucket is a rotating vane that takes the energy out of moving steam so as to spin the rotor. These buckets must be machined to highly accurate contours in lengths up to 43 inches at present and, in the future, to lengths of 50 to 60 inches. Maximum width is 12 inches. The material is type 403 stainless steel, 201-241 Bhn. Previously, buckets were made on rise-and-fall millers and form cutters. Additional operations were required to reach the required shape.

Currently, buckets are machined on tape-controlled Ex-Cello-O machines. Each machine, *Fig.* 1, has a base-mounted longitudinal table for the headstock and tailstock between which the work is chucked. Roller supports back up the workpiece against the thrust of the cutter. Another slide at right angles holds the cutter head. Initially, the cutter is set at a predetermined place relative to the center line of the bucket and the worktable is preset relative to the center line of the machine. The cutter moves in and out to conform to the desired shape as the workpiece traverses past it during successively indexed strokes. Machining time is from one to four hours, depending on the amount of metal removed. Brazed-in carbide-tipped cutters are employed and life of the cutter averages about four hours, operated at 600 rpm. All the milling cuts are $\frac{1}{8}$ to $\frac{1}{4}$ inch deep, with an 0.005-inch feed per cutter tooth. The Carboloy grade 883-cutter removes $2\frac{1}{2}$ cubic inches of metal per minute.

Once the operator presses the starting button, the tape control system takes over. He has no further operations to perform on the machine except in an emergency or to change cutters or to reload.

In preparation of the tape that controls the machine, data taken from blueprints are transferred to punched cards. These, with a program deck, are run through an IBM 704 computer that computes the basic shape of the bucket, then the cutter path. Output of the computer is recorded on half-inch magnetic tape. This is fed into an electronic director that interpolates the digital data information on velocity, time and directions, and furnishes continuous tool path information in the form of a one-inch magnetic tape. The tape in turn controls the milling machine.

Fixturing for the tape-controlled operation is relatively simple and no three-dimensional master

is required. New designs can be put into production in a few days, since there is no need to wait three to four months for preparation of a master template. Also—a significant point in planning—the tape-controlled machines have been designed with sufficient capacity to accommodate foreseeable size increases in turbine buckets.

Tube Sheets: Comparable versatility is found in a numerically controlled high-speed Hill drilling machine, *Fig.* 2. The machine is used in drilling tube sheets and tube supports for heat exchangers. Each heat exchange unit has an average of seven plates and a generator may have as many as eight coolers—as many as 56 plates per generator. Plates are either circular or rectangular, with a maximum diameter of four feet or two feet square. Some require as few as 100 holes and others as many as 2000 holes.

The machine has a tilting table, loaded in the horizontal position. When the workpiece has been clamped on the table, hydraulic cylinders, operated by a pushbutton, raise the table into vertical position for drilling. The table is automatically locked by a hydraulic cylinder-controlled pin mechanism and all holes are drilled automatically under tape control. Punched tape, prepared from typewritten instructions, is used to carry out all operations. During the automatic cycle, the machine operator taps or deburrs previously drilled plates on other machines in his area.

Productivity made possible through numerical control is enhanced by the high speed of operation of the machine itself. The single spindle is run at speeds from 1200 to 1800 rpm, depending on material thickness. It drills holes in single plates as thin as $\frac{3}{8}$ inch, or in stacks as thick as 10 inches, at speeds of 8 to 10 inches per minute in steel, brass and bronze. Combination tools make it possible to ream and chamfer as well as drill without tool changes.

Carriage movement is 84 inches per minute or about $1\frac{1}{2}$ seconds between holes. Chips are removed by a conveyor.

Conductor Bars: A spectacular reduction in lead time and manufacturing time has been effected in the production of generator conductor bars. The bars are extrusions with a lower rib section and an upper cover section which, when placed together, form a hollow conductor. They are about $1\frac{1}{2}$ inches wide, $\frac{3}{8}$ inch high and about 25 feet long. Plugs are inserted between the ribs, welded in place and a number of machining operations performed.

The bars are produced on a numerically controlled Simmons machine in 45 minutes after a simplified engineering drawing has been completed and programmed on punched cards. This job formerly required 16 weeks of lead time and 60 man hours of production time. Total production time savings are extremely large, since 250 to 300 bars are required for each steam turbine generator.

Both the rib section and the cover section are arranged parallel on the ways of the machine, *Fig.* 3. About 250 operations are performed on the machine, which has six heads. The first head performs a wire brushing operation and actuates clamps to hold the material being worked. Each bar requires about 26 slugs for blocking passages. These are automatically fed from a hopper to Head No. 2 and welded in place. Heads No. 4, 5 and 6 perform a series of machining operations. Carbide cutters are used. Cutters are preset before being inserted into the spindles. Cutter life between changes is about 80 bars.

Clamps that hold the workpiece are automatically actuated by air through the use of special arms attached to the spindles. This arrangement pro-

Fig. 3. Punched-card controlled machine for generator conductor bars. Six heads perform a total of 250 operations automatically. Total cycle time is about 45 minutes.

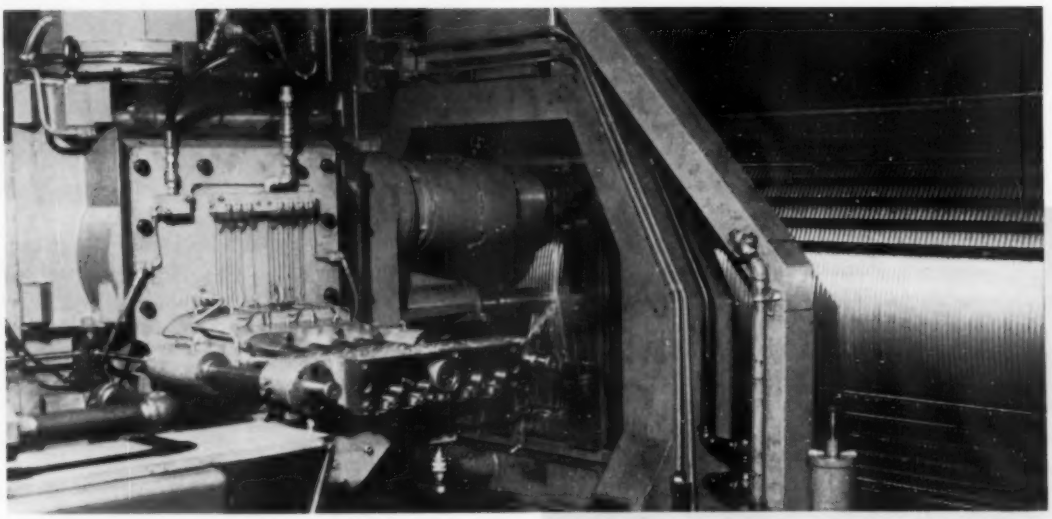


Fig. 4. Multiple-spindle turret drilling and reaming machine produces thousands of holes in each generator rotor.

vides protection against the possibility of the cutters running into the clamps during machining.

The machine itself is approximately 90 feet long and 8 feet wide, with a 32 foot long worktable. Heads are controlled electrically, hydraulically and mechanically as required. Two punched-card readers are provided to control operations. Punched cards, rather than tapes, are used because of the complexity of the operations. It is not possible to put sufficient information for the operations on conventional eight-channel control tapes.

Generator Rotors: Another numerically controlled machine tool is used to drill and ream more than 2700 holes in generator rotors. The rotors weigh up to 90 tons and are as much as 24 feet long. This 28 foot long Baker horizontal machine is equipped with a four-sided turret, *Fig.* 4. Each turret has a removable head containing five spindles for drilling and reaming. The spindles can hold drills up to 1¾ inches in diameter. Maximum hole depth is 12 inches.

It is possible to remove the drilling heads and mount, on one of the faces of the turret, a vertical slide that will hold a multiple-spindle head for tangential milling of air entrance slots. Gearing in the turret provides a 30-hp output at each face. Spindle speed is variable over a 4:1 range by a d-c motor whose speed is set by the machine control tape. Hydraulic feed speed of the slide is also controlled by the tape, as is the positioning for drilling of each group of holes.

The numerical positioning control employs selsyn feedback. The director portion of the control receives information from a tape reader and supplies reference voltages to selsyn pickup units that are coupled to machine motions. The pickup units supply an error signal proportional to the difference in the desired position and actual position of the motion. Positioning is complete when the error signal reaches zero.

To move the carriage, the monitored error signal from its selsyn pickup unit is amplified and excites amplidyne field windings. An amplidyne motor-generator set is used as a power amplifier to feed the d-c carriage drive motor. Positioning accuracy is 0.0005 inch. Traversing is at 290 ipm; positioning at 36 ipm.

To move the slide, the monitored error signal from its selsyn pickup unit is applied to hydraulic control valves that serve hydraulic feed cylinders. Intermediate positions are established to the nearest 0.100 inch. A positive mechanical stop is used for final depth positioning and slide rear limit.

All operations are fully automatic. The operator assigned to the machine sets up the workpiece, sets up and operates tool grinders installed near the machine, selects and places tools in the heads, maintains tool, fixture and tape inventories and performs general area housekeeping. Much of this work is done while the machine is on a long drilling cycle or during a 20-minute warm-up period at the beginning of each job. The machine performs operations formerly accomplished by numerous standard radial drills and boring machines.

Turbine Shells: Much heavy metal removal is required during the roughing of turbine inner shells. The inner diameter of these steel castings varies from 16 inches to 5 feet and, in many cases,

two inches of metal is removed on the radius. In the past, this boring was done on vertical boring mills with large tables to brace and support the workpiece. These machines ran at slow speeds.

Currently, turbine inner shells are rough and finish bored on a special Morton vertical stub bar machine. The machine consists of a crosshead with a 24-inch quill and 12-inch boring bar supported from four columns, *Fig.* 5. A turning ring is also set within the columns so that the outer diameters of the shells can be turned in the same setting used for boring. The machine is loaded with the table in front of the column structure. Then the table is moved into position within the columns, the outer turning ring is lowered, braces for the workpiece are swung into position from the columns and the boring head structure is brought down into position.

The machine is equipped with a numerical positioning system. Control is by pushbutton: the operator dials the position to which he wants the tool to go and presses a button and the tool goes to that position with a maximum error of 0.001 inch. Although it would be simple to add tape or punched card control, such a control would be uneconomical for the operations involved.

Many of the operations accomplished on the inner diameter of the workpiece are invisible to the operator from his control station. However, a television camera provides a direct visual image of the metal-cutting operation and a full-size template, showing the profile of the workpiece, shows the operator the exact tool location at all times. Thus there is no need for the operator to leave his control station to inspect the progress of the work.

The machine replaces three to four conventional machines, due to its high metal removel rates. Also, work is considerably more accurate than with the previous machines and provision of the turning ring eliminates the need for secondary operations.

Cutting Tool Improvements

Automation is a method of improving machine productivity by eliminating operator effort, both mental and physical. With the advent of newer machines designed with high-production rates in mind, the application of automation has often been accompanied by the application of better cutting tool materials. At General Electric, many of the newer machines are equipped with carbide tooling. Wherever possible, standard toolholders and standard inserts are used, to cut tool costs still further.

Tooling for the Morton stub boring machine is a case in point. When turbine inner shells were produced on conventional machines, high-speed steel tools were used. Grooving, parting and radius cuts wore out from 30 to 40 high-speed steel tool bits per shell, each costing from 20 to 35 dollars. On the new machine, carbides are used exclusively, resulting in an initial saving of about 60 percent in tooling investment. Over 90 percent of the chip-making operations are accomplished with standard off-the-shelf tools; the remainder are performed with minor variations of standard tooling, with the exception of machining a few special radii.

For a boring cut, stock removal with high-speed steel was 9.3 cu in per min, as compared to 79.2 cu in per min with carbide tools. Depth of cut with high-speed steel was $\frac{5}{8}$ inch, feed was 0.079 ipr, speed was 18 fpm. With grade 370 carbide, using two positive rake inserts, feed is 0.030 ipr; speed is 220 fpm. Tool life, cutting chrome-vanadium-molybdenum alloy steel castings, 225-260 Bhn, is 20 minutes per edge.

Disposable carbide inserts have also resulted in important savings. On a Betts deep grooving lathe used for machining turbine rotors up to 20 feet in length, replacement of brazed-on cutting tools with disposable inserts results in savings of $166.42 per

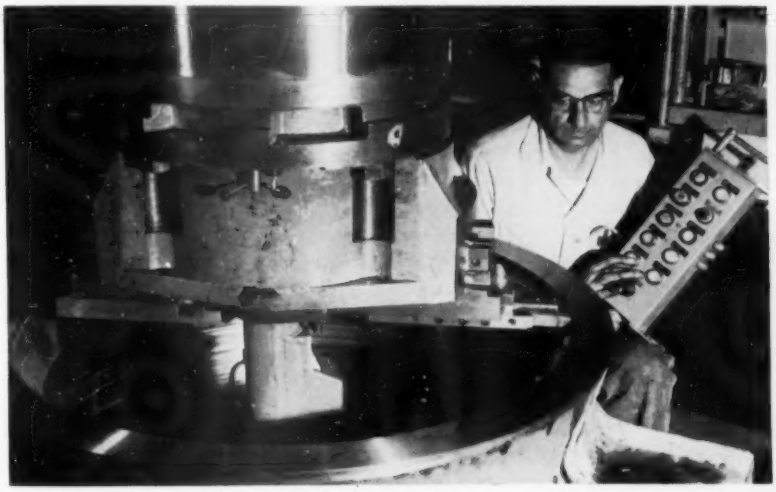


Fig. 5. Boring head is equipped with two carbide tools that cut simultaneously. Television camera at center of head makes it possible for operator to view progress of operations that cannot be seen from control area.

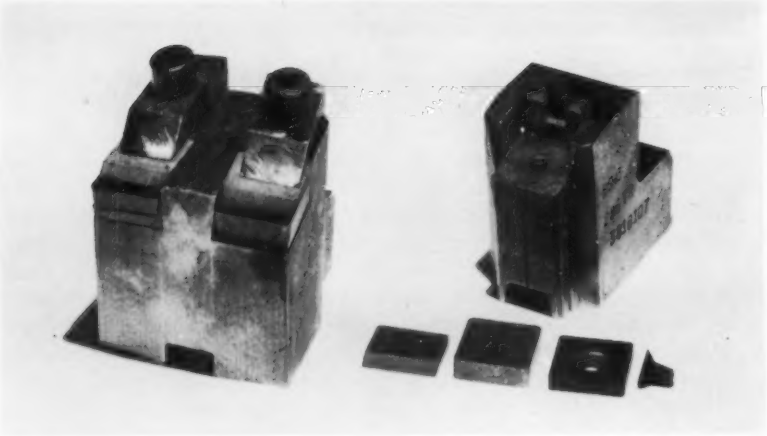


Fig. 6. Disposable insert tooling for grooving turbine rotors. Double toolholder is used at front of lathe; single toolholder, placed at rear of lathe, cuts area not reached by double tools, completing cut.

rotor. Only six disposable inserts are required to produce 11.5 grooves, as compared to 35 brazed-on tools. Also, it is possible to take a wider cut with the disposable inserts and metal removal has been increased from 96 to 168 cu in per min. Tools and toolholders are shown in *Fig.* 6.

Management Problems

Return on investment is, of course, the guiding criterion when considering capital equipment. The new machines described represent an extremely large investment. Cost of the four turbine bucket milling machines was around $1 million, and the stub boring machine was installed at a cost of over $1 million. The multiple-spindle drilling machine represents a $500,000 investment. These machines are expected to pay for themselves in a maximum of five years. Close study of alternative processes is necessary before these large investments are made, making the tool engineer a key man in investment decisions.

Once new facilities are installed, they must be utilized to the utmost. This is largely a management problem. General Electric engineers feel that in order to insure that facilities are efficiently utilized, a businesslike approach must be communicated to all personnel. In the past, an attempt has been made to do this through the foreman.

A new approach to this problem has been to divide the entire plant into a large group of component businesses. Each of these small businesses is headed up by a manager of shop operations. The manager is in complete charge of ordering material, scheduling, planning and setting piece prices of the product. It has been found that such managers develop an understanding of the economic need for efficient operation and are able to communicate this need to their workers. In effect, the line of communication between top management and the machine operator is shortened. In this way, machine efficiency ultimately becomes matched by human efficiency. The result is better facilities utilization and lower-cost production.

Forming Cylindrical Shells

PARTS similar to those ordinarily made with deep drawing techniques can be formed at lower costs by using a new process developed by the Floturn Div. of the Lodge & Shipley Co. The process is based on the use of a standard Floturn machine plus one or more reforming operations performed on a press.

A typical example is the production of 500 stainless steel shells, three inches in diameter by seven inches deep with a 0.042-inch wall thickness. Deep drawing methods would involve a total of ten shearing, drawing, washing and annealing operations. The Flo-Reform process requires only six operations and results in a 28 percent cost saving.

In producing the part by the new process, a $6\frac{7}{16}$-inch diameter blank is used, including a $\frac{1}{8}$-inch trim allowance. The blank is 0.125 inch thick. This blank is formed into a truncated cone on a vertical Floturn machine. After forming, the cone is washed and annealed, then reformed into a straight side cylinder in a single press operation.

Due to the intensive cold working of the material in the Floturn process, tensile strength is increased, grain structure is shorter and more homogeneous, grain orientation is improved and stress direction is also improved. Wall thickness of the shell is much more uniform than can be obtained by drawing.

Gadgets

Ingenious Devices And Ideas To Help
The Tool Engineer In His Daily Work

Layout Tool

Laying out contours of parts to be inspected with an optical comparator is time consuming when using a conventional scale and protractor. The attachments for the vernier caliper illustrated speed layout and improve accuracy.

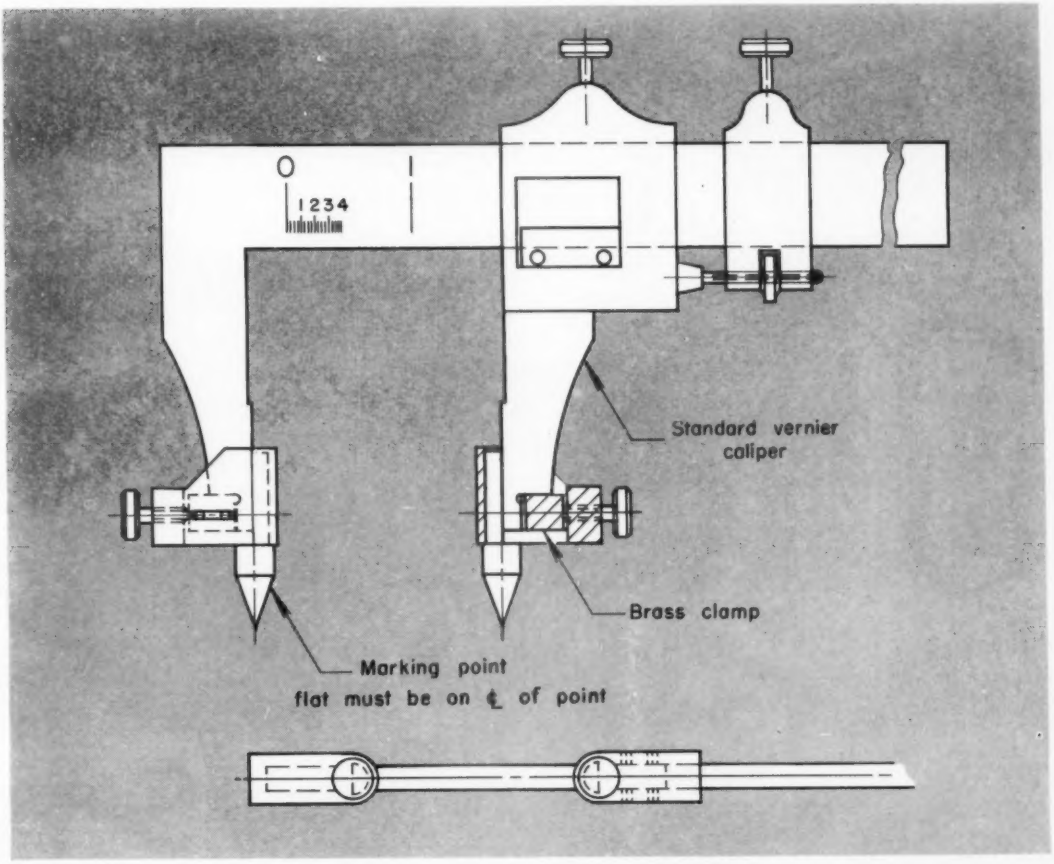
COMING!

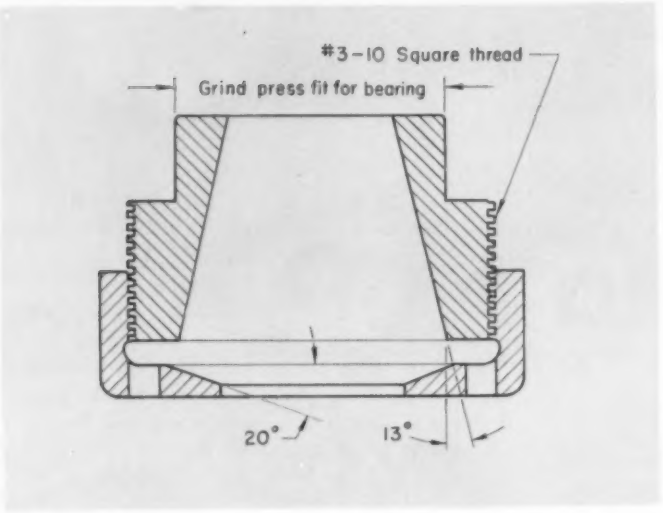
Gadgets Contest: List of cash prizes and contest rules are published on page 103 in the ASTE News Section.

The caliper is set in the same manner as for taking outside measurements. The sharp points are used to make slight prick marks on a paper drawing. Pencil lines are then drawn over these marks. Consistent accuracy of 0.003 inch can be maintained.

When the paper layout is complete the part outline is transferred photographically to the glass comparator plate. During humid weather, the layout should be photographed the same day it is completed to avoid errors due to expansion of the paper.

Robert M. Dickson
Springfield, Mass., Chapter

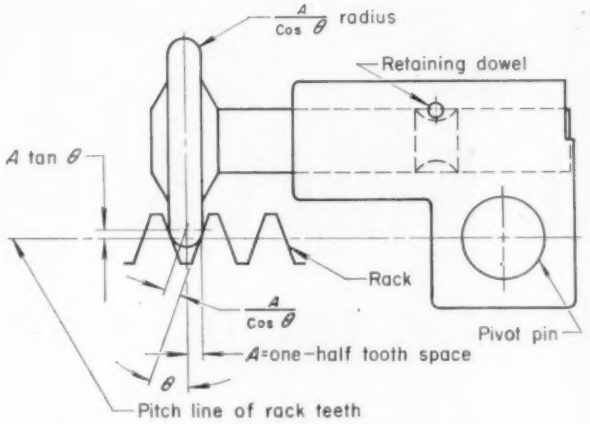




Collet Chuck

Tubes can be accurately bored with the collet illustrated, which permits both ends of the workpiece to be adequately supported. The collet consists of a shop-made chuck fitted with a "rubber collet" as used in Jacobs spindle-nose chucks. A ball bearing is pressed over the chuck. The outer race of the bearing is clamped in a standard lathe steady rest. Hole alignment and concentricity are excellent with this holding method.

John Dudonis
Bethpage, Long Island, N. Y.



Flush-Pin Rack Gage

Rack teeth can be inspected quickly and accurately with the gaging pawl illustrated. To make the gage work properly, the center line of the pivot pin must coincide with the pitch line of the rack teeth.

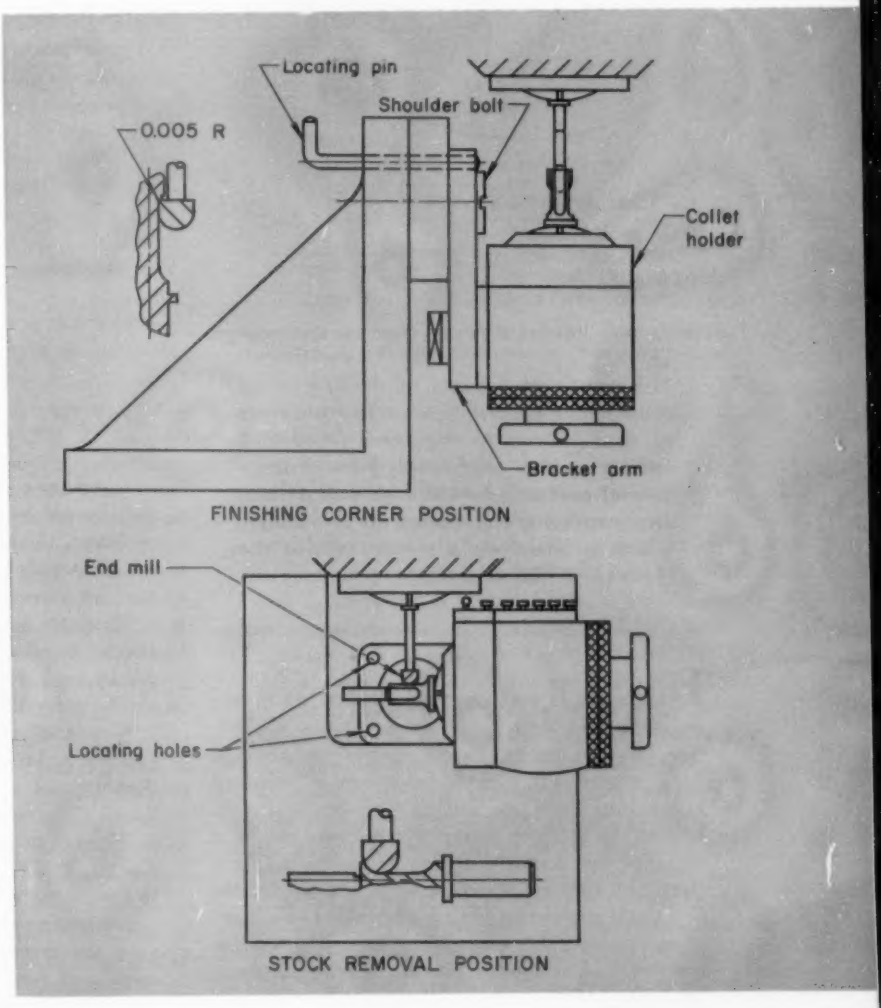
F. A. Adams
Dayton, Ohio

Milling Fixture

When milling with a ball end mill on a surface parallel to the axis of the cutter, breakage may result because of excessive radial forces due to high bearing area. Using the fixture illustrated, a shorter cutter can be utilized to reduce breakage.

The workpiece is held in a collet mounted in a holder taken from a tap sharpener. The collet holder is mounted on a bracket arm that pivots on a shoulder bolt. A locating pin positions the bracket in either the horizontal or vertical position. After the part is inserted in the collet, most of the stock is removed by machining with the axis of the cutter normal to the work. The fixture is then rotated 90 deg and the remaining stock in the sharp corner is machined out.

Klaus L. Schlesinger
Los Angeles Chapter



STANDARD or SPECIAL DRILLS

. . . proper application reduces costs

By Carl J. Oxford, Jr.*
Director of Research
National Twist Drill and Tool Co.
Rochester, Mich.

The economic aspects of drilling when considering special or standard tools are of vital interest to engineers faced with setting up for production jobs. Fundamental cost relationships as well as tool applications are discussed in this article which is based on a recent talk at the Houston ASTE chapter.

DRILLS are in such common use that many tool engineers take them for granted. Proper application, however, can be a source of significant savings.

An understanding of the advantages of standard and special drills, as well as their limitations, is helpful. A primary reason for the selection of a standard over a special drill is its availability from stock. In addition, standard drills are not limited to a single application but are adaptable to a variety of operations. This adaptability, as well as the low cost per tool, is another reason for selecting them.

*Senior member ASTE Detroit chapter.

Disadvantages of standard tools are found when they cannot do the job or their performance is not optimum. Also, size and finish of the work may not be satisfactory or the drilling cost per piece may be excessive.

There are two circumstances where special tools should be selected. These are where the job can not be done with a standard tool and where costs can be reduced with special tools.

With small quantities of special drills, high initial cost per tool may be a disadvantage. Further, since they are not available from stock, a longer lead time and correspondingly increased plant inventory is required to prevent interruptions in production. Another limitation of them is usually limited only to the job for which they were designed.

Illustrating the fundamentals of tool performance, the graph in *Fig.* 1 shows how both cutting speed and feed affect tool life. These curves are representative and apply in a general way to all

cutting tools. As either the feed or the speed is increased, tool life is shortened. Usually, tool life is reduced more by an increase in speed than it is by a corresponding increase in feed. This observation leads to one fundamental principal: generally, the feed should be selected to give the most satisfactory cutting action and then the speed should be adjusted to give the most economical tool life.

With drills, this usually means the use of the highest possible feed per revolution and moderate cutting speeds. For twist drills it appears that the drill life in holes per grind varies inversely with some power of the cutting speed or feed. The speed exponent appears to be between two and three and the feed exponent is in the vicinity of 1.5. These relationships assume that the drill wear is essentially abrasive in nature since it has been found that beyond some critical speed or feed the cutting edge temperature becomes so high that wear is heat sensitive. When this occurs, the tool life is even less than that predicted by the power law relationships.

After these relationships are determined, a cost picture can be built using the methods developed by W. W. Gilbert and others. Such a cost picture is shown in *Fig.* 2 where cost is plotted against cutting speed. Similar plots can be drawn with feed as a variable, but speed is the most frequent economic variable. From *Fig.* 2 it can be seen that as the cutting speed increases the actual time of machining goes down, so the cost of running the machine is reduced. However, as speed increases, tools wear out more rapidly, causing tool and resharpening costs to rise. In the plot, the minimum total cost occurs at a relative speed of 100. This minimum point is usually fairly broad-nosed so that a cutting speed within ten to fifteen percent of the optimum does not change the cost greatly.

Effect of tool life on machining costs and optimum cutting speed are shown in *Fig.* 3. In this case, it is assumed that all tools have the same cost per tool, but that the tool life varies. For comparison, the curve labelled 100 is the same curve as the total cost curve in Fig. 2 The curve labelled 200 indicates that the tool life is doubled, while those labelled 50 and 25 show reduced tool life. When the tool life is doubled, the minimum cost occurs at a slightly higher cutting speed. With lower tool lives, the minimum cost occurs at lower speeds.

The low-speed end of *Fig.* 3 is particularly interesting in that it shows cost to be relatively independent of tool life. This means that if a job is produced under typical tool room conditions it becomes questionable whether it is worth while investigating the use of special tools to improve tool life. Here, it would be best to use standard tools if they will do the job.

If a job is operating on the high-speed side of the minimum cost point in an effort to secure maximum production, it is likely that a special tool which will give better tool life will result in a reduction in costs. While the comparison shown in *Fig.* 3 is based upon the assumption of the same cost per tool, it is often found that a more expensive special tool which gives improved tool life, will result in a reduction in cost. This is particularly true in the case of drills and other tools which are sharpened several times during their useful life. In such cases it is possible for the total resharpening cost to exceed the initial cost of the tool. Thus, the increased cost of the special tool has a less than proportionate effect upon the total tool cost.

Sometimes the maximum production rate attainable can not be used because product quality will deteriorate. A good example of this is an end mill cutting a slot as shown in *Fig.* 4. The dashed line shows where the tool was supposed to cut during the operation, but if the feed is increased to obtain a higher production rate, the slot is actually cut as

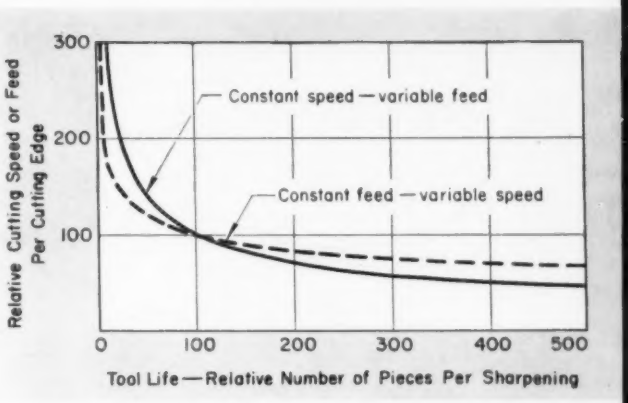


Fig. 1. Both speed and feed plotted against tool life. With constant speed, the feed is variable and with constant feed, the speed becomes the variable.

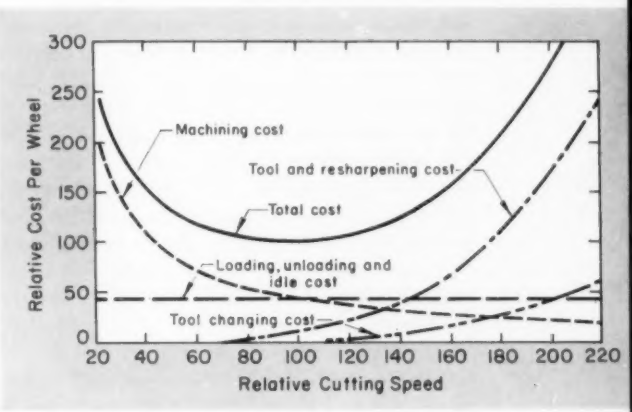


Fig. 2. Cost curves based on relative cutting speed. Many factors affecting total cost are included.

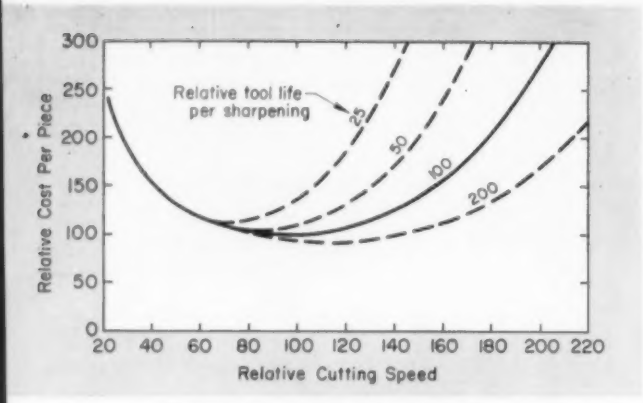


Fig. 3. Effect of changing tool life per sharpening on the cost per piece produced.

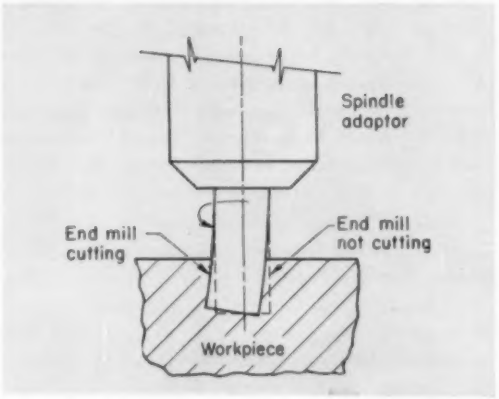


Fig. 4. Theoretical and actual positions of an end mill during cutting of a slot.

shown by the solid lines. The illustration is not distorted as much as it would appear at first glance. In a recent check, a one-half inch end mill was used to cut a slot one-quarter inch deep. The tool was a standard four flute end mill of the fast spiral type. The feed was on the heavy side at 0.012 ipr, or 0.003 inch per tooth. Actual measulement of the maximum deflection showed it to be 0.015 inch, so that a keyway machined under these conditions would be located off center. Thus, tool deflection can be a major consideration in establishing operating conditions. Sometimes, special tools can be designed to minimize such deflection and allow higher production rates.

An interesting example of a special drill doing a better job than a standard drill is the use of a short flute drill for sheet metal work, as in assembly of automotive bodies. The drilling is done with a portable hand tool. With the long fluted standard drill, the breakthrough burrs often hook the drill flutes and pull the drill rapidly through the work until the burr hits the end of the flute and is sheared off. In production, this rapid traverse often ruins the part through impact with the drill chuck. Often the drills breaks. With short flute drills the hole is drilled and the burr sheared off before much momentum is built up. These special drills are usually ordered in large quanties so the premium cost per individual tool is not great. In fact, users have found that the cost of using such special drills is actually lower than that for standard drills because breakage is greatly reduced.

While proper tool design can improve rigidity and tool life, the gains can not be fully realized unless the machine tool is also rigid. *Fig.* 5 shows an idealized drill press as it appears when standing idle and under operating conditions. It is not uncommon with an ordinary drill press to find deflections of more than 0.010 inch in the machine when using ¾ inch drills to produce holes in a medium steel. The best and most rigid drill coupled to a flimsy drill press will not perform well.

Another example of the use of special drills is the common multidiameter tool of which there are two types. One is the step drill on which the two diameters are ground on one set of lands. The other is the subland tool in which two sets of lands extend the entire flute length of the drill. Construction of both types is shown in *Fig.* 6. Straight fluted drills are shown for the sake of simplicity but the principals are the same for the more common helically fluted tool. The upper part of *Fig.* 6 shows the step drill. The lower illustration shows subland construction. The subland tool has the advantages that it is easier to sharpen and that any length of step can be used.

The relative merits of the step drill and the subland drill can be shown by examining two applications. In some setups there is only a given length of drill that can be used before the drill becomes too short for the job. The choice between the step or subland tool would depend upon the length of the step. When a step drill is resharpened on the large diameter the small diameter is nicked slightly and eventually the small diameter is completely destroyed because of this. In a long step as shown in *Fig.* 7, the step drill survives the useable life of the tool since both tools are the same length when service life is completed. The subland drill provides only reduced chip room in the flutes and a higher cost per tool. For such an application the step tool should be used.

The case of a short step is illustrated in *Fig.* 8. Here the step tool can be reground only once before the small diameter is entirely consumed. When this happens, the only way to restore the tool to use is to cut off the tool in back of the original small diameter and regrind the small diameter. Every other regrind requires this operation of cutting off the tool in the same way. With a subland

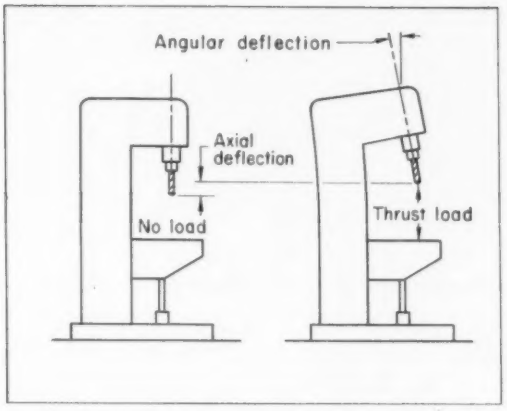


Fig. 5. Drill press under conditions of no load, left, and thrust load, right. A thrust load on the spindle produces angular and axial deflections.

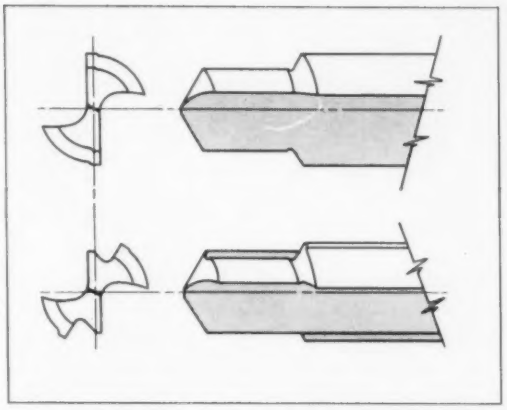


Fig. 6. Comparison of step and subland construction of multiple diameter tools. The step tool is located at the top and subland drill is at the bottom.

tool, the two diameters extend the full length of the tool so it can be sharpened back as necessary. After four grinds, the subland tool is still longer than the step tool after the second regrind. In this case, the subland drill, which has a higher cost per tool would give a lower tool cost per piece.

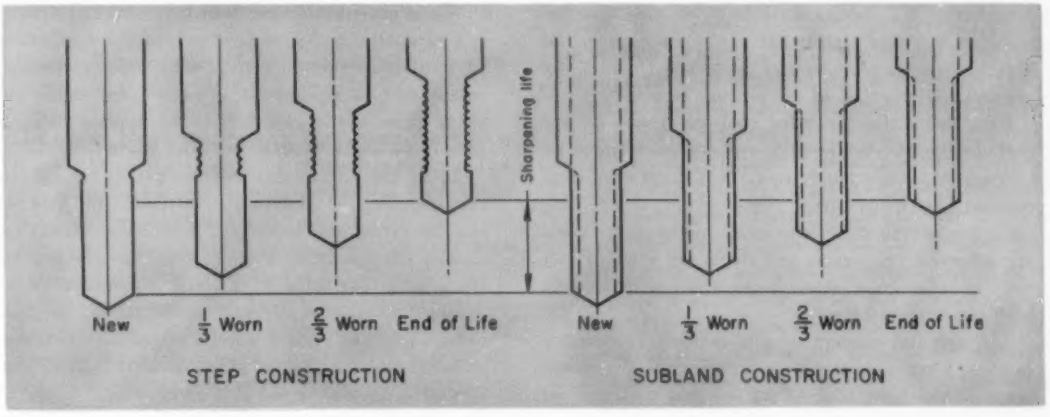
Aside from producing holes with multiple diameters, the step drill has been found to be useful for producing accurate holes with portable drilling equipment. The small diameter is not used to produce anything on the finished part, but rather provides a pilot for the finishing diameter. The usual instability at entry into the workpiece and resultant bell mouthing occur with the pilot diameter, but the pilot becomes stabalized before the large diameter starts to cut. This permits the large diameter to enter the work smoothly and produce accurate holes. For many aircraft applications, this has eliminated the need for reaming.

In recent years a great deal of interest has developed in another highly special tool, the gun drill. This is a single fluted tool and is called a gun drill because it was first used to produce the long accurate straight holes required in gun barrel work. Many manufacturers require holes which are accurate and straight, but not necessarily long. The gun drill has been adapted to this type of work with outstanding success. Gun drills must be properly guided, supplied with high pressure cutting fluid and operated at proper speeds and feeds on well aligned machines.

There are two basic types of gun drills. The first cuts to center as shown in *Fig.* 9. The other one, *Fig.* 10, cuts around the core, being a borderline trepanning tool. With the trepanning or target type there is some improvement in guiding due to the core, and it also eliminates the zero speed area at the center where carbide does not function too well. For blind holes, the center cut tool is used because it eliminates the problem of core removal.

Cutting fluid for gun drills is fed down the hollow shank. It escapes up the flute during drilling

Fig. 7. Effect of resharpening of multiple diameter drills. Both tools remain the same length with corresponding amounts of resharpening when the small diameter steps are rather long relative to tool length.



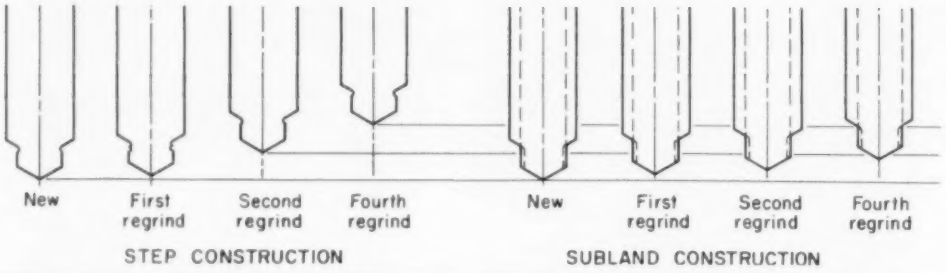


Fig. 8. For short steps, the subland construction is best from the standpoint of resharpening life and cost. After second grind, the step tool must be cut off and the step completely reground.

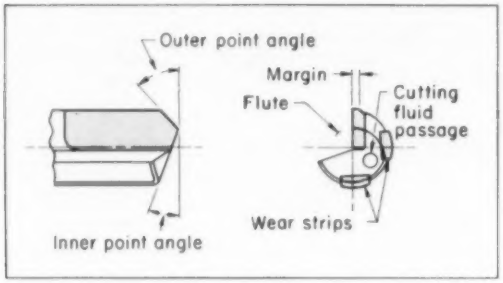


Fig. 9. Design detail of the center-cut gun drill tip.

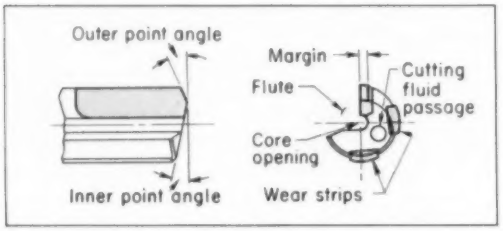


Fig. 10. Design detail of the tip of a target or trepanning gun drill. This tool cuts around a core.

and washes out the chips. The chip removal function of the cutting fluid can be more important than cutting fluid action, since good chip ejection is essential to successful gun drilling. An additional function of the cutting fluid is to provide lubrication for the wear strips that guide the drill in the hole. The cross sections of *Figs.* 9 and 10 show the general construction of the cutting heads.

Gun drills usually have carbide heads or are carbide tipped. While they are normally operated at feeds which are much lower than those used with conventional twist drills, the cutting speeds are much higher so that reasonable penetration rates are achieved. However, gun drills are used principally to produce accurate holes and not to achieve high penetration rates.

The original concept of gun drilling involved a rotating workpiece and a stationary drill. In recent years it has been found that the gun drill can be successfully rotated. The development of satisfactory high-speed, high-pressure rotary cutting fluid couplings has made this change possible.

Rotation of gun drills has permitted their application to large workpieces. In one case a block of steel weighing about thirty tons was gun drilled on a large horizontal boring machine. There were 264 holes $2\frac{1}{8}$ and $2\frac{5}{8}$ inch diameter, to be drilled through a 30 inch thickness. Straightness requirements were 0.007 through the entire thickness of the block. With the gun drill the holes were produced with an average straightness error of only 0.002 inch. Tooling for this job was expensive, but it was worthwhile because the job could not be done in any other way.

Another development along the same line is the use of gun drills in air driven portable tools. The air tool used has one important feature necessary for successful gun drilling and that is a positive mechanical feed. The speed of the spindle is determined by the air motor, but the feed is geared to the spindle so that the feed per revolution is constant. It is interesting to compare the conventional gun drilling machine to the portable tool. A conventional two spindle gun drilling machine, such as those used for gun barrel work, has a current price in execess of $15,000 while the portable tool with a four inch stroke and a drill capacity of about one-half inch has a cost of less than $1,000.

While the portable machine is limited to the drilling of shorter holes, it does permit the application of gun drills to many jobs with only a nominal investment in equipment. Further, the small machine permits the gun drill to be applied to large structures which cannot be easily moved.

Every hole producing operation requires careful consideration to determine whether standard or special drills are required. The wide variety of special purpose twist drills currently available from stock will take care of a high percentage of all drilling operations. Special drills should be used only where the desired results can not be obtained with standard drills or where analysis shows that special drills will result in a reduction of costs.

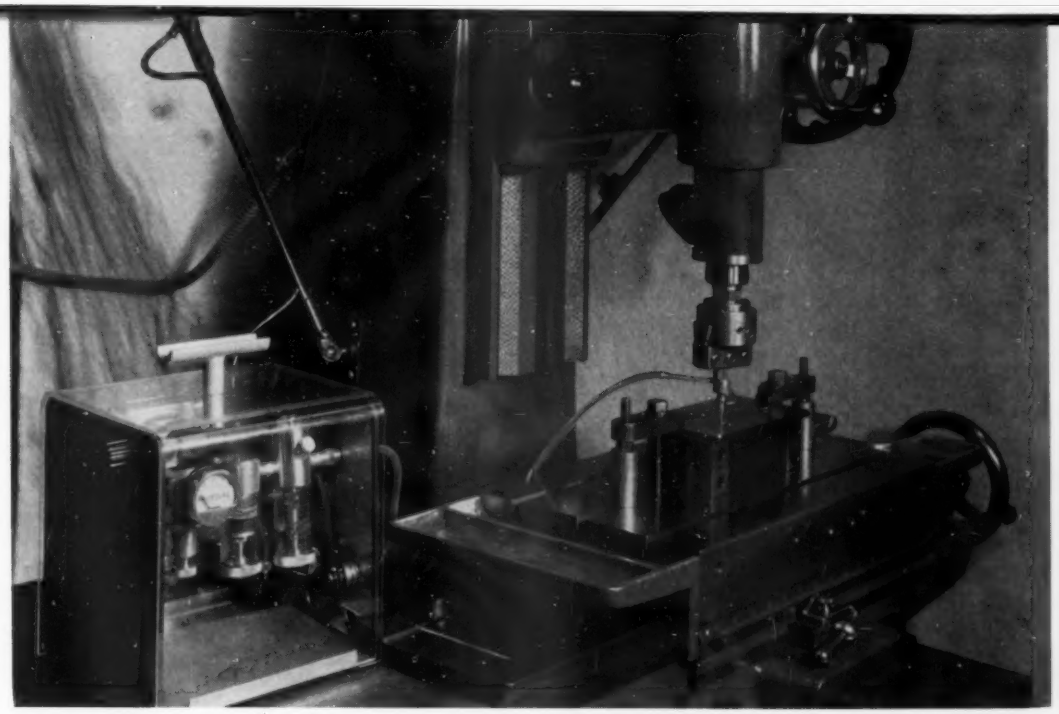


Fig. 1. Setup for enlarging hole in a die block. Airotor is in position for machining. Offset boring head carries it around the periphery of the the hole. Unit at left houses pressure regulator and filters for air supply.

FINISHING HARD MATERIALS at 300,000 rpm

Ultrahigh-speed machining of carbides and hardened steels is now a production reality. These speeds are generated in a versatile pneumatic tool that performs die finishing operations ten times faster than conventional equipment.

By T. W. Black
Senior Associate Editor

RECENT DEVELOPMENTS in high-speed machining have excited the interest of all tool engineers. For the most part, these developments have been made possible by innovations in cutting tool materials and are restricted to applications where large amounts of metal are removed.

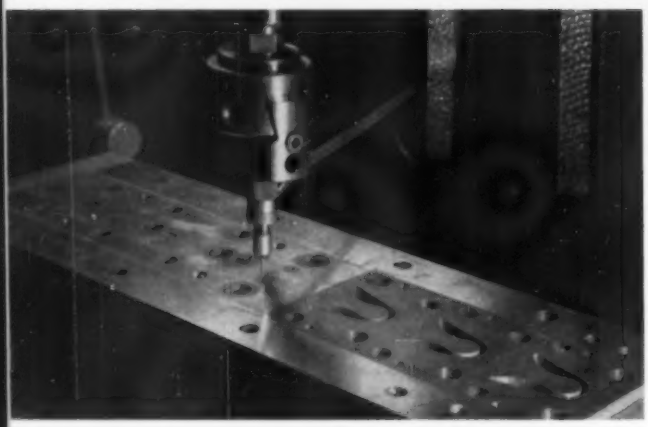
An equal need for improved efficiency exists, however, in precision finishing operations on smaller workpieces such as dies. Although the amount of metal removed is small, some operations require many hours, particularly on hardened materials and the various types of carbides.

These operations are being expedited in several plants with an air tool that is capable of spindle speeds in the 300,000-400,000 rpm range, *Fig.* 1. It is possible to machine materials as hard as as 62 R_C at high rates of speed, using carbide burs, and to machine carbides, using diamond mounted points, with greatly improved efficiency.

A typical application is milling slots in a jet aircraft component. The material is SAE 8615 alloy steel, carburized, aircraft quality, 58-60 R_C. Formerly, the manufacturer milled the slots while the steel was in the annealed condition and hardened the piece after milling. With the new tool, called the Airotor, it is possible to perform the milling operation after hardening, eliminating distortion caused by the hardening process. It is possible to hold tolerances within 0.001 inch.

Fig. 2. Right-angle head is used for milling groove around the ID of a hardened workpiece, which is rotated in an engine lathe.

Fig. 3. (below) Airotor in position for opening up the ID of a carbide insert in a die block.



In another grooving operation, *Fig.* 2, a workpiece is mounted in an engine lathe. Workpiece hardness is 62 R_C. As the workpiece is rotated, a $\frac{1}{16}$-inch circular groove is machined around its inside diameter. In this case, the tool is being used with a right-angle attachment. In the operation shown in *Fig.* 3, the tool is mounted in an offset head on a jig borer for opening up holes in a carbide-insert die block. The tool is also used manually, *Fig.* 4, for finishing a large insert in the same die block. It is also suitable for sinking intricate shapes in hardened material, utilizing tracer milling equipment.

Another time-saving die application is machining identification letters on a Stellite marking die at the Campbell Chain Co., York, Pa. The die is used to stamp identification letters on chain links. Some 40 minutes were required to grind the identification letters on the die with conventional methods. The same job is accomplished in eight minutes with the new high-speed tool.

Comparable time savings were shown in tests conducted by the Hanover Tool Co., Hanover, Pa. Under normal production conditions, a series of holes was drilled in $\frac{1}{4}$ inch thick steel, using a carbide bur. The holes varied in diameter from 0.025 to 0.170 inch. Distances between centers varied from 0.3674 inch to 0.3805 inch.

After the steel was hardened to 62 R_C, the holes were machined to predetermined sizes with the Airotor. Distance between centers was brought to a uniform 0.375 inch, $\pm$0.0001 and parallelism was maintained to the same tolerance. The amount of metal removed per hole was from 0.007 to 0.0275 inch. Finishing time per hole ranged from 8 to 18 minutes. Normally, these holes would have been finished by lapping. Estimated lapping time was estimated at one-half to three hours per hole, depending on hole size. For a series of 11 holes, total lapping time was estimated as 21 hours, 45 minutes, as compared to actual finishing time of 2 hours, 18 minutes with the air-powered tool.

The tool was developed by the Ashcombe Co., York, Pa. All of the working parts are contained in a rotor head about $\frac{3}{8}$ inch in diameter and $\frac{1}{2}$ inch long. With a standard carbide bur in the collet, the over-all length is approximately one inch from the tip of the bur to the top of the head. The shank of the bur can be shortened to bring the length to $\frac{3}{4}$ inch. Shanks of the burs and diamond-mounted points have a standard 0.0625-inch diameter. All of the moving parts necessary to achieve the ultrahigh speeds are contained in a cartridge that can be replaced in one or two minutes.

Shop lines delivering air at pressures of 40 to 125 psi power the tool. A control unit, *Fig.* 1, regulates air to a usable pressure of 30 to 50 psi. All air is passed through a double filter system. The primary air filter has an automatic dumping mechanism for discharge of accumulated water. A second filter contains a five-micron element to eliminate small particles that might cause damage to the rotor.

Fig. 4. Light manual pressure is sufficient for finishing operations on a carbide insert in a blanking die.

Also in the control unit is an automatic lubricator that mixes a fine lubricant with the air supply in the form of a fog. The lubricant is carried by the air to moving parts in the head assembly. It is not intended as a coolant or lubricant for the work; all machining is done dry. Air flow is controlled by a manually operated off-on switch so no electrical supply is required; however, a solenoid-operated remote control switch can be incorporated where necessary or convenient.

Spindle speeds are measured electronically. A white line is painted on the spindle shaft. As the shaft turns, a photoelectric cell sends an impulse to a counter each time the white line enters its field of view. In this way, speeds up to 400,000 rpm have been recorded.

With the tool under load, the actual revolutions per minute are, of course, somewhat reduced. For manual operations, extremely light "tool pressure" is used. The tool itself does the work. There is no tendency for the tool to climb during machining. Effort and "feel" for writing on hardened steel are comparable to that for writing with a fountain pen.

As in the case with other fields of ultrahigh-speed machining, no full scientific explanation of the improved efficiency gained by ultrahigh speeds has been developed. Apparently, at extremely high speeds most of the heat energy generated in cutting is transferred to the chips, rather than the tool. Consequently the tool does not heat up while cutting and bur life is excellent, even when cutting hardened materials.

At present, only a few of the dozens of different types of possible applications have been explored. A grinding wheel manufacturer is presently developing miniature wheels for use with the Airotor. With these wheels, it will be possible to grind at surface foot rates comparable to those used for normal toolroom grinding of large workpieces, despite the small diameters of the wheels. The wheels will materially extend the range of applications for the ultrahigh-speed air tool.

Vapor Deposition of Metals

SUCCESSFUL MODIFICATION of a long-known process for vapor phase deposition of chromium, molybdenum and tungsten to produce adherent coatings of the metals on various materials has been announced by Alloyd Research Corp.

Potential applications, utilizing chromium as a protective corrosion-resistant cladding for valves, tubing and other equipment, are possible in the chemical, dairy and food industries. Promising electronic industry applications include coating of certain components with high purity, high density tungsten to prevent contaminants in the base materials from adversely affecting emission.

The possibility exists of fabricating thin electronic parts of refractory metals in this manner. Heavy coating of tungsten on graphite also appears possible for missile and rocket nozzles.

Compared with electroplated chromium, the new coating is nonporous, less brittle and does not risk hydrogen embrittlement of the substrate. "Throwing" power permits coating of complex shapes.

Qualitative bend tests of chromium coatings up to 0.005 inch thick on copper and steel show no indication of cracking, spalling or flaking after extensive deformation. The same thickness of chromium deposited on copper gave complete protection to the base metal when immersed in a 20 percent nitric acid solution during a test period of 64 hours.

designed for

PRODUCTION

Special Machine Simplifies Assembly

Hopper-fed assembly machines make possible substantial savings in time and cost over manual assembly. Developed by Waldes Kohinoor, Inc., this machine is designed for the high-speed assembly of retaining rings on a control knob stud and disk assembly.

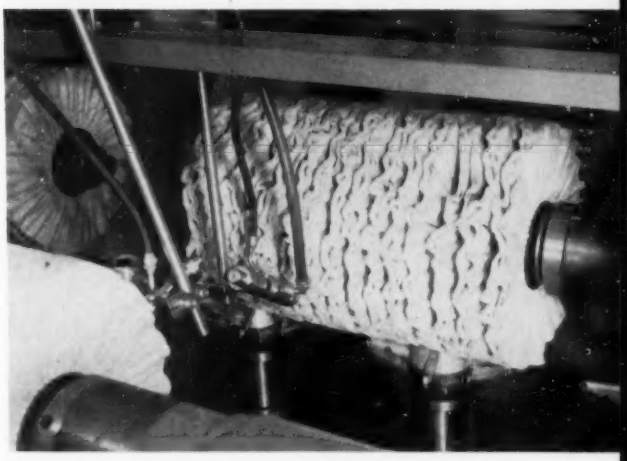
A vibratory hopper feeds rings in single file onto an inclined chute to an escapement that releases one at a time. When released, a ring slides down the remaining portion of the chute and drops onto a free-floating tapered mandrel that is held by two mechanical fingers. The diameter of the mandrel bottom is slightly larger than the shaft diameter on which the ring is assembled.

The machine has a nest fixture that holds the workpiece during mounting of the retaining ring. To actuate the machine, the operator places the workpiece in the nest and pushes it forward. A sleeve operated by an air cylinder fits closely over the mandrel and positions the retaining ring. As the ring is pushed over the wider portion of the mandrel, it is spread open to pass over the stud end of the workpiece and snap into a groove on the stud.

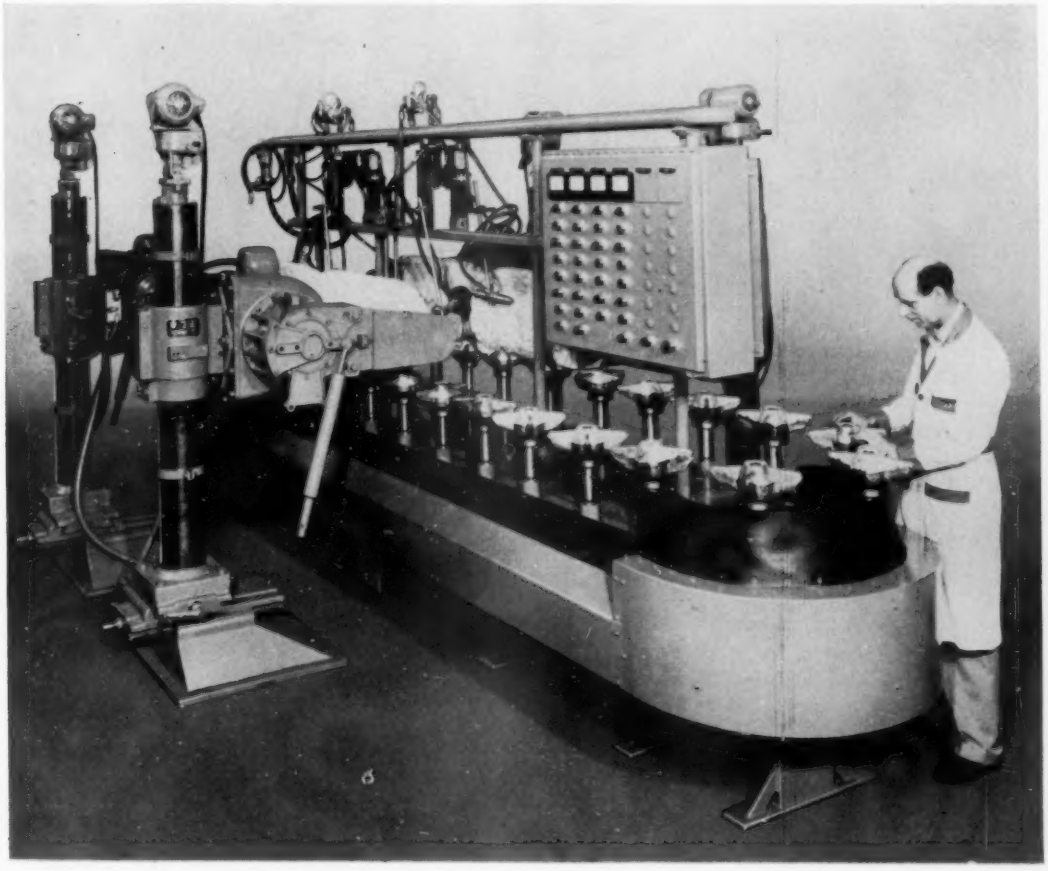
Conveyor Base Provides Flexibility

An in-line conveyor moves cast-iron platens around the periphery of an automatic polishing machine to provide compactness and flexibility. The machine, developed by Acme Manufacturing Co., has a special motorized chain drive to move the platens at controlled feed rates from 4 to 20 fpm. Work spindle assemblies, attached to each platen with dovetail mountings, can be driven in either direction by separate, fixed or motorized, roller chain arrangements. They are used in any position on the conveyor to provide optimum polishing speeds. Spindles are also provided with cammed surfaces to provide preset work motion.

The polishing or buffing operations are performed by separate adjustable polishing heads placed around the periphery of the conveyor unit. Each unit is provided with rotating buffs, polishing wheels or abrasive belts to perform the desired operations as shown on the illustrated machine.



TWO WORK STATIONS covered by one long buff during a finishing operation on the hub cap spinner.



Tape-Controlled Machine Powered by Hydraulics

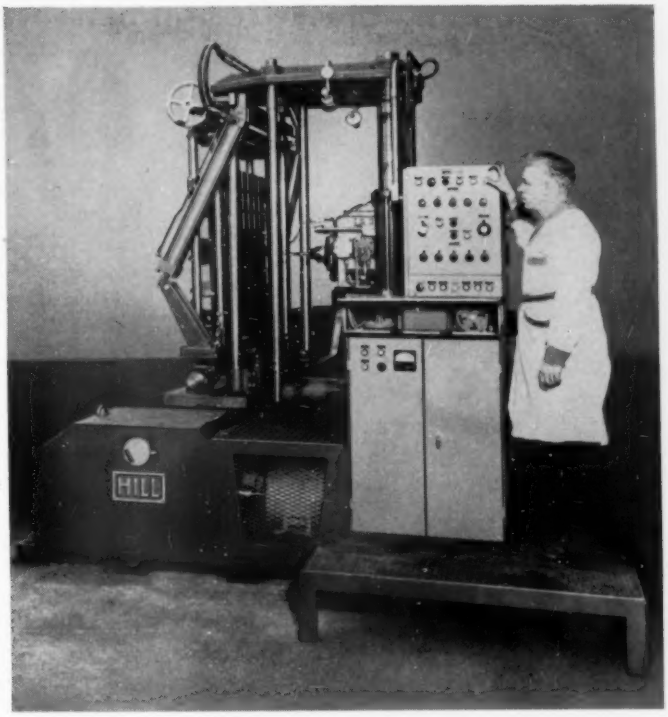
Drilling, milling and jig boring operations on job lot production are facilitated by using a simplified numerically controlled single-spindle machine. Developed by Walter P. Hill, Inc., the machine is controlled by General Electric universal positioning system. The hydraulic powered spindle enables the machine to drill or gun drill a ¾ inch diameter hole in steel at feeds up to 30 ipm. Economical features of the machine include the low horsepower numerically-controlled positioning system in conjunction with the special hydraulic controls for machine movements.

Counter-balanced cylinders eliminate the need for servo valves. Three hydraulic systems are employed. One is used for the table drive, the second is for raising and lowering the head, while the third provides the drill feed and table tilt function.

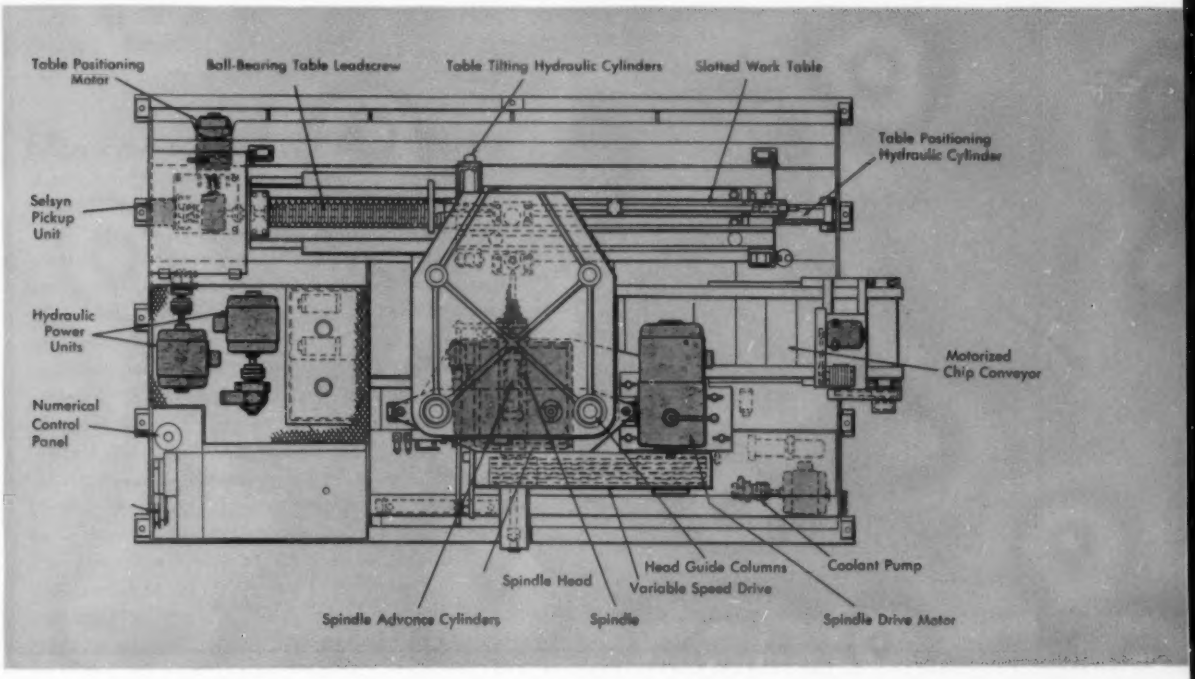
Work loading operations are improved by the tilting work table. As a result, setup time between jobs is reduced. When loaded, the table is returned to the vertical operating position and locked by a hydraulic cylinder-controlled shot pin mechanism.

LOADING WORKPIECES on a tilted down table of the numerically-controlled drilling and jig boring machine.

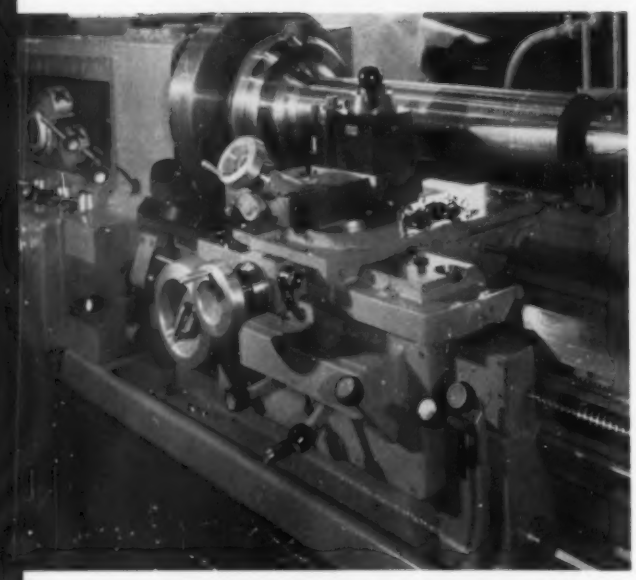
OPERATOR at the console of the numerically-controlled drilling machine. Tape feed unit on control panel is mounted below the push-button console to facilitate observing and changing the program tapes without leaving the control panel.



DRILLING MACHINE showing the location of the major components. Motorized conveyor carries chips out of the working area.



Building Block Design Simplifies Construction



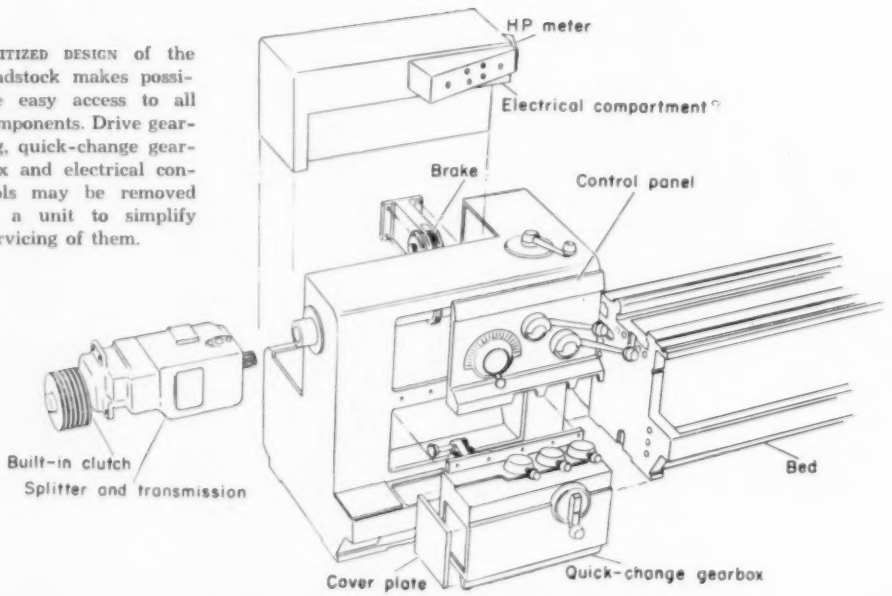
CARRIAGE OF LATHE during a cut using carbide tooling. The rigid front wall that takes most of the force of the cutting loads has been extended to the floor.

Modular construction of machine tools provides for the interchange of standard components to make a machine with selectable features. This construction is used in lathes developed by Clearing Div. of U. S. Industries, Inc. Welded steel beds are keyed and bolted to the headstock to facilitate alignment and to permit changing from one size or type of bed to another. Alignment is insured by having larger rectangular keys in both the horizontal and vertical planes together with four leveling jacks on the bed.

Interesting design features of the machine are the unitized components to facilitate maintenance plus the convenient location of the controls that are easily reached by an operator in standing position. Drive gearing, quick-change gearbox and electrical controls may be removed as units as shown in the illustration to simplify servicing. The feed gearbox is enclosed and attaches to the front of the machine complete with hand wheels and levers.

Forty spindle speed changes are designed into the machine at spaced intervals with 13.6 percent steps. A rotary slide rule picks the correct code for speed changing. Moving two levers puts the spindle into the desired speed for the machine operation.

UNITIZED DESIGN of the headstock makes possible easy access to all components. Drive gearing, quick-change gearbox and electrical controls may be removed as a unit to simplify servicing of them.



air-hardening GRAPHITIC STEEL lower tool and die costs

By C. F. Jateznak • O. A. Pfouts* • D. J. Girardi
Steel and Tube Div.
The Timken Roller Bearing Co.
Canton, Ohio

Graphitic tool steels are easier to machine than conventional steels. A new air-hardening graphitic steel is simpler to process than oil-hardening and water-hardening varieties, making it an exceptionally desirable material for tool and die applications.

DURING THE PAST SEVERAL YEARS, the popularity of graphitic tool steels has steadily increased. These steels give exceptional performance in dies and their attractive processing characteristics have lowered die production costs. Heretofore, graphitic tool steels have been available only in water-hardening and oil-hardening varieties. Recently Graph-Air, an air hardening type was developed. This steel combines the good characteristics resulting from the presence of graphite with the advantages of air hardening, notably, easier processing.

Presence of graphite in tool steels results in unusual physical properties. Graphite acts as a chip breaker and dry lubricant during machining and as a stress-relieving medium during hardening. The static coefficient of friction of graphitic type tool steel is about 50 percent lower than that of conventional tool steels. Also, graphite reduces the modulus of elasticity. A low modulus of elasticity

Fig. 1. Slots being milled in perforator die. Material is an air-hardening graphitic tool steel that has excellent machinability and good service life.

*Senior member ASTE Canton chapter.

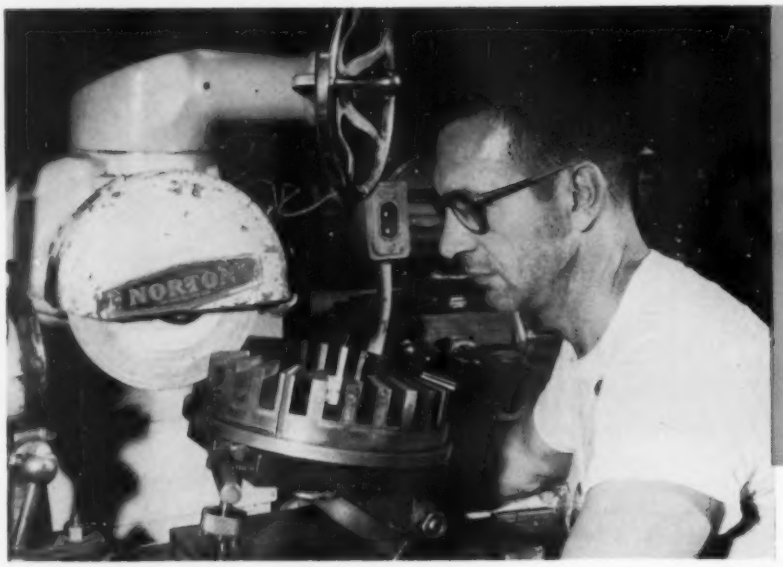


Fig. 2. Following milling operation, slots on perforator die are ground to finished size.

is important for improved wear resistance. More elastic straining of the wear surfaces is possible before tearing takes place. Several typical die machining operations are shown in *Figs.* 1 and 2.

Analysis: Major alloying elements in the new air-hardening graphitic tool steel are manganese, silicon, nickel and molybdenum. These elements confer high hardenability. The nickel and silicon are balanced against the carbide-formers, manganese and molybdenum, to obtain the desired graphite content (0.20 to 0.60 percent). This alloying combination is such that the graphite content resulting on cooling from hot working or annealing is rendered exceptionally stable for further reheating or hardening as required.

Because of the alloy combination of the new steel (1.35 percent C, 1.85 percent Mn, 1.20 percent Si, 1.85 percent Ni and 1.50 percent Mo), it can be heat treated from the same temperatures (1450-1500 F) and in the same salt baths and furnaces as the standard water-hardening and oil-hardening tool steels. An additional feature of the analysis is the high carbon content. The necessary reservoir of carbon for formation of graphites and carbides is assured. Also, the high carbon content insures high surface hardness, even if surfaces are not protected during hardening. Moderately decarburized regions in high-carbon steels containing nickel and molybdenum always produce higher hardenability than the parent material. Thus, should the carbon content drop to as low as 0.60 percent, the high hardenability of the decarburized layers will assure useful hardness in excess of 58 R_C. More severe decarburization will result in a loss of hardness. This loss is, of course, undesirable.

Hardening: The new tool steel is capable of hardening to R_C 60 in still air, at the center of a six-inch round. In actual proctice, a four-foot-long, eight-inch-diameter section has been successfully hardened to R_C 58 in still air from 1500 F. Even larger sections can be hardened from this temperature if agitated air cooling or partial oil quenching to black heat followed by air cooling is used. Also, sections larger than eight-inch rounds can be satisfactorily air hardened from 1700 F if this operation is followed by a high-temperature temper. This procedure is, however, not recommended because of the added chance of scaling and decarburization. Normal hardening, followed by faster-than-still air cooling, is preferred. Transformation characteristics are shown in *Fig.* 3.

The best hardening temperature range for the new material is 1450 to 1500 F. Use of this temperature range has produced hardnesses from 59 to 62 R_C in one to six-inch round sections. The lower hardnesses are obtained with the larger sections. Higher hardnesses and less retained austenite are obtained by resorting to cold treatment at —100 F directly after hardening. Hardening temperature ranges are shown in *Fig.* 4. Under normal conditions the aggregate hardness of Graph-Air is about two Rockwell "C" points lower than the actual hardness of the martensitic matrix. This lower aggregate hardness stems from the inability of the Rockwell "C" brale to miss the numerous graphitic pockets in the steel.

Recommended hardening procedures are as follows: For cross sections up to two inches thick, the material is heated to 1450 F and held at temperature for one hour plus 30 minutes per inch of thickness or outside diameter. The same procedure

Fig. 4. (right) Effects of austenitizing temperature on hardness and retained austenite of air-hardening and conventional steels.

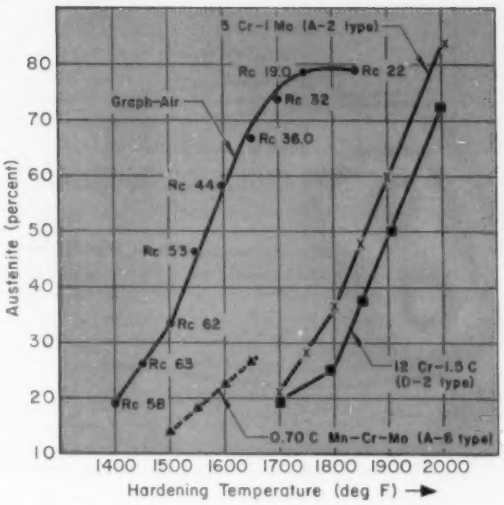
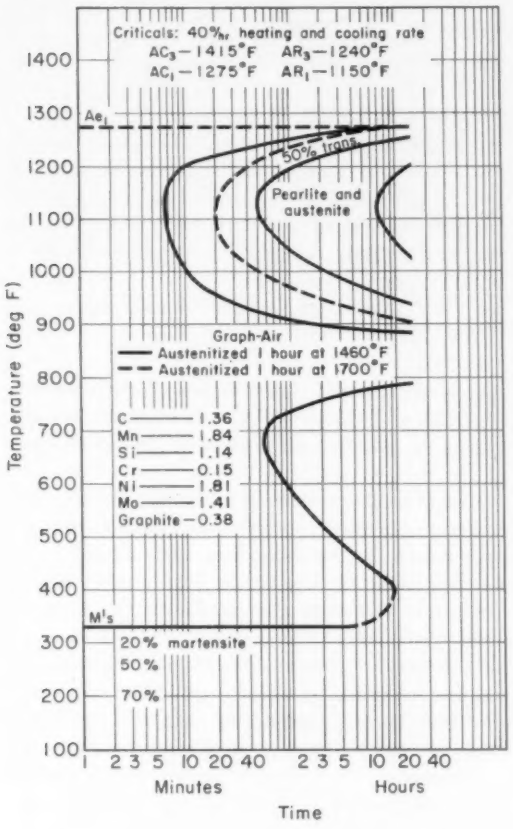


Fig. 3. (below) Temperature-time transformation of the air-hardening graphitic steel.



is followed for larger sections, with heating temperatures of 1475 F for two to four-inch-thick sections and 1500 F for sections thicker than four inches.

After the material has been held at temperature for the required time, it is cooled in air to room temperature. It is important that room temperature be reached before tempering or unsatisfactory hardness will result. A good practice is to air cool until the piece can be handled with bare hands, then cool in water to remove all heat before tempering. Temper is required to hold size, hardness, and/or maximum impact strength. Double tempering is recommended. Effects of tempering temperature on hardness are shown in *Fig.* 5.

For large sections, fan cooling or partial oil cooling at the rate of 30 seconds per inch of minimum cross section, followed by air cooling, can be used to expedite cooling and to minimize scaling in air. Good size control is obtained by these methods.

Preheating before hardening is not necessary but is considered good practice, especially after heavy machining operations on intricate sections. A reducing atmosphere or neutral salt bath treating is recommended. In strongly oxidizing atmospheres in open furnaces, surface protection can be obtained by painting all surfaces with a seven-percent boric acid solution (by weight) in water; by packing the piece in spent nonburning carburizing compound; by packing in cast-iron chips; or by wrapping in well-matted newspaper. The steel can be rehardened directly, but a somewhat lower hardness will result. It is preferable to temper in the range of 1000 to 1200 F prior to rehardening.

Dimensional Stability: Characteristic dimensional changes that occur during air hardening and tempering are shown in *Fig.* 6. These changes depend on the ratio of martensite to austenite present at any given time. During still-air hardening from 1450 to 1500 F, Graph-Air expands over green dimensions. On tempering to about 350 F, the material shrinks, due to the tempering of martensite. Above 350 F to about 650 F, growth takes place as the retained austenite is converted to martensite and/or bainite. Above 700 F, the material returns, essentially, to its original green dimensions. The magnitude of the dimensional changes during still-air hardening and tempering is exceptionally small. These changes amount to a few tenths of thousandths of an inch movement per inch and are essentially equal in longitudinal and transverse directions. This movement is at least as small as that for the 1.5 percent C, 12 percent Cr, 1 percent Mo type D2 steel, which is reported to be excellent in this regard.

Data have also been obtained on size changes in large and complex sections. These data show that

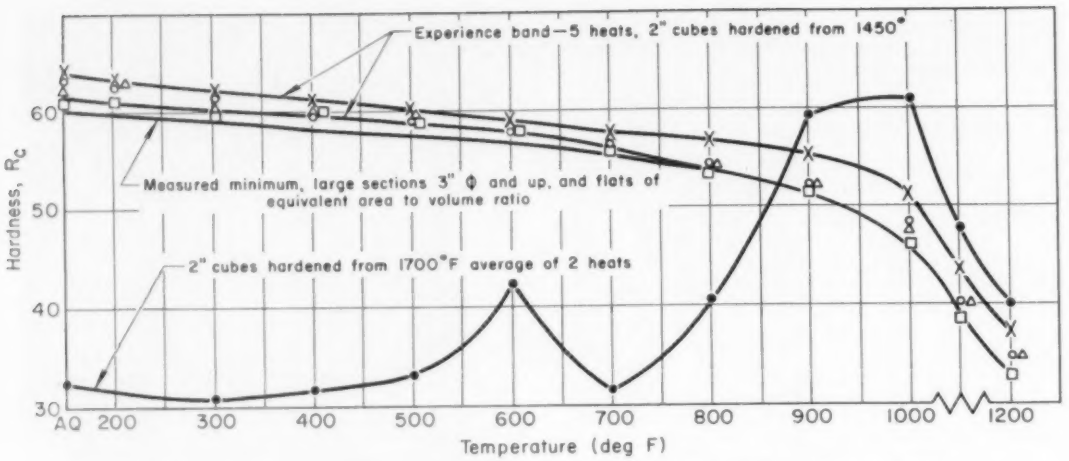


Fig. 5. Effects of tempering temperature on hardness of air-hardening graphitic tool steel.

Graph-Air has excellent nondeforming characteristics. Effects of cold treating directly after hardening, and after hardening and tempering, have also been studied. Cold treating directly after hardening converts a considerable amount of retained austenite to martensite. This results in a large growth of dimensions and the nondeforming properties of the material are destroyed, as shown in *Fig. 7*. A moderate increase in hardness is obtained, however.

Cold treating after hardening is commonly used to obtain long-time dimensional stability. With the new steel, the retained austenite is strongly stabilized in the hardening and tempering operations, so cold treating is actually not required. When long-time dimensional stability is required, cold treating after tempering is recommended as an added precautionary measure. This treatment assures long-time stability without incurring the large dimensional changes that arise from deep freezing directly after hardening.

Mechanical Properties: Toughness of Graph-Air as measured by unnotched Izod impact is comparable with results published elsewhere for A2 and D2 high-chromium air-hardening steels. The elastic modulus of annealed Graph-Air is 28.5 x 10^6 psi, as compared to 32 to 34 x 10^6 psi for nongraphitic annealed tool steels. For steels in the hardened and tempered condition, these values would be somewhat lower; however, they would remain in the same relative order. The modulus of the graphitic steel would be lower by about 4 to 5 x 10^6 psi.

Wear resistance of the new material is excellent. Field test results in various die applications have shown it to be as wear-resistant as the D2 type high-carbon, high-chromium tool steel. Because of the presence of graphite, Graph-Air apparently is superior to D2 in nongalling and nonpickup characteristics. If carefully run in with a few cycles of light load application, prior to full production runs, dies made of the new steel take on an almost mirror-like polish, which seems to increase wear resistance.

Hot Working: Due to its higher carbon content, the new steel requires lower temperature for satisfactory forging than does type A2 steel. In this respect, it resembles type D2 tool steel, which also can be forged at relatively low temperatures.

Several forms of hot working have been successfully employed: rolling, press forging and hammer forging, including upsetting. In hammer forging, care must be exercised not to forge too rapidly or excessive heat build-up (2000 F) may occur, causing rupturing. The best practice is to work only fast enough to hold the original furnace color in the workpiece. The steel can be safely worked to at least 1700 F without rupturing; it apparently maintains plasticity down to this temperature.

Only minor amounts of graphite are present during normal hot working operations. Graphite precipitation occurs on holding or cooling through the temperature range of 1300 to 1400 F. To prevent over-graphitization, long-time holding is avoided.

The recommended hot working practice is as follows: preheat slowly to 1500 F and soak well. Heat to 1900 F, soak well, then proceed with forging or rolling. Do not forge below 1500 F. Do not equalize at temperatures between 1400 and 1800 F. If necessary, equalize at forging temperature or above 1800 F. Cool in air to cherry red color, then bury in sand, Sil-O-Cel, ashes or other insulating medium for slow cooling. Do not normalize forgings; proceed directly with annealing.

Annealing: Annealing characteristics of Graph-Air are primarily controlled by the solution-forming elements nickel and silicon. Together, these elements increase the ferrite or matrix hardness

enough to preclude the attainment of annealed hardnesses below 229 Brinell, even with extremely long cycles. Annealed hardnesses ranging from 235 to 255 Brinell (with a 269 Brinell maximum) are readily obtained and machinability has been found to be very good at these hardness levels. Annealing times are about equivalent to those necessary for types D2 and A6 tool steels.

Prior structure influences the final annealing results. As a general rule, the more homogeneous the austenite of a high-carbon steel is rendered by high-temperature treatment, the more prone that steel is to the formation of lamellar pearlite and the more difficult it is to spheroidize during annealing. The microstructure of air-cooled Graph-Air forgings normally contains large quantities of relatively homogeneous austenite, some martensite and only a few carbide particles. Even with slow heating rates during reheating for annealing, this as-forged prior microstructure will produce some lamellar pearlite in the fully annealed part.

Microstructures produced by normalizing in excess of 1600 F will produce similar undesirable results after annealing. The undersirable as-forged microstructure can be corrected by heating slowly to just above the critical temperature, then cooling fairly rapidly to room temperature. The homogeneous austenite is conditioned in this manner and carbide nuclei for spheroidization are formed. This prior treatment, followed by a normal annealing cycle employing a low austenitizing temperature (1440-1460 F) produces a completely spheroidized structure in the steel.

Full annealing is accomplished as follows:

1. Heat to 1440 F and hold two hours
2. Cool to 1000 F at 40 deg per hour
3. Air cool to room temperature
4. Reheat to 1440 F, hold one hour per inch of section
5. Cool to 1260 F at any convenient rate
6. Cool to 950 F at 15 deg per hour
7. Air cool to room temperature.

Softening for major rework of hardened and tempered-and-hardened parts is done in two cycles:

Cycle A

1. Heat to 1440 F and hold two hours
2. Cool to 1260 F at any convenient rate
3. Cool to 1000 F at 20 deg per hour maximum
4. Hold to 1000 F for three hours
5. Air cool to room temperature.

Cycle B

1. Heat to 1440 F and hold two hours
2. Cool to 1200 F at any convenient rate
3. Hold at 1200 F for 16 hours
4. Cool to 1000 F at 20 deg per hour maximum
5. Air cool to room temperature.

Packing or use of controlled atmosphere to prevent decarburization is recommended if working surfaces are to be protected.

For minor rework operations, workpieces are softened by tempering nine hours at 1200 F maximum. In all of these annealing operations, the graphite content will remain relatively undisturbed.

Machining: Machinability of Graph-Air is not quite as good as that of oil-hardening graphitic steels but compares favorably with that of conventional nongraphitic oil-hardening tool steels. The new steel is reported to be less sensitive to grinding damage than conventional oil-hardening grades. The presence of graphite in the microstructure of the graphitic tool steels prevents any rapid build-up of surface stresses during grinding. Graphite particles

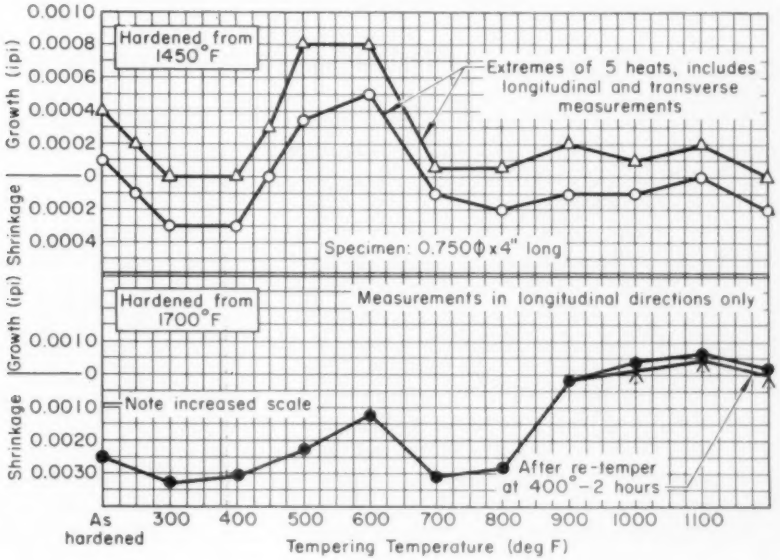


Fig. 6. Dimensional changes caused by tempering Graph-Air steel.

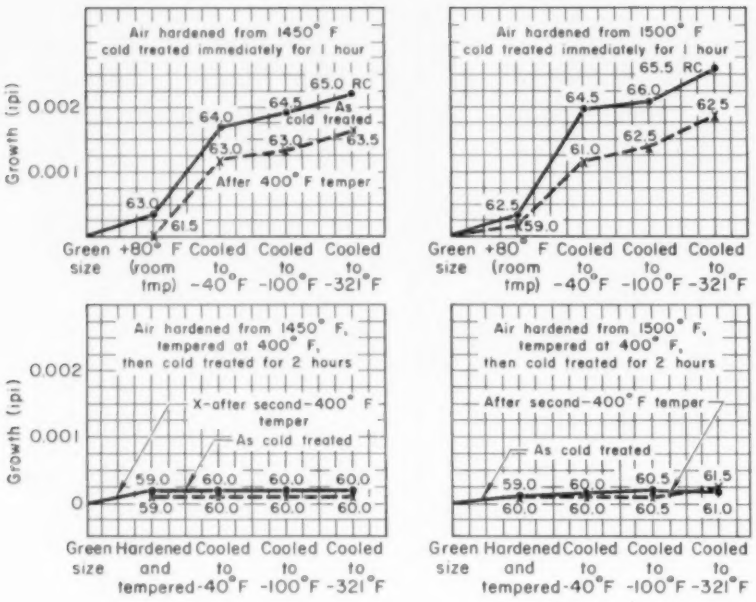


Fig. 7. Changes in dimension caused by various heat-treating and cold-treating combinations during tests.

are built-in discontinuities that prevent stress build-up and thus inhibit crack formation.

The following wheels or their equivalents are recommended for grinding the new steel:

Cylindrical grinding: 38A60-18VBE, 32A60-J8VBE, 9A603-J2-VOS

Internal grinding: 32A60-J8VBE, 32A60-J5VBE, 9A604-K2-VOS

Surface grinding: 32A60-F12VBEP, 9A603-G3-VOS

Wet grinding is recommended where possible.

Welding: Hardened Graph-Air can be welded with either oil-hardening tool steel electrodes such as Eureka 71M or with a specially developed air-hardening rod. Both rods will produce hardened weld deposits. Material in the annealed condition must be welded with an air-hardening rod to produce effective hardening in the weld material when the annealed part is fully hardened. It is recommended that parts be preheated to 450-500 F prior to welding. Under-bead cracking is not a problem.

Air-hardening graphitic tool steel combines a number of desirable characteristics—good service life, ease of processing and relatively easy machining and welding. These characteristics make this new material a valuable addition to the growing family of cost-cutting tool and die steels.

Welding Thin Materials

NORMAL FUSION welding methods using conventional type power supplies with either covered electrodes or inert-gas shielded processes give too much heat and cause uncontrolled melting when making butt, lap or fillet welds in thin material. With a "Short-Arc" welding process developed by Linde Co., Div. of Union Carbide Corp., manual and mechanized welding of thin material is possible with excellent control of the weld puddle.

The outstanding feature of this inert-gas consumable-electrode process is the ability to make manual fusion welds in all common metals such as carbon steel, stainless steels, aluminum and copper, in all positions and with all types of joints. Thickness of the material can range from 0.030 to 0.100 inch, with a 0.040-inch minimum thickness for aluminum.

The arc, operating in the range of 30 to 125 amperes, 14 to 19 volts, short circuits dozens of times per second. This produces a small cold puddle pinpointing the location of the arc heat. Normally, 0.030-inch diameter wire is used, although 0.020-inch diameter wire works well on material in the low end of the thickness range.

Considerable study has been given to evaluating shielding gases and mixtures and selecting the best in each instance. Argon has been found suitable for metals such as aluminum, copper and Everdur. For stainless steel and carbon steel, argon-oxygen and argon-carbon dioxide mixtures are finding wide acceptance. Pure carbon dioxide is being used for some steel applications but it provides somewhat more spatter than the mixtures.

Fig. 1. Automatic arc welding of a stamped flange to a machined hub of an automotive transmission support.

tooling for
automatic arc welding

By R. A. Wilson
Director of Application Engineering
The Lincoln Electric Co.
Cleveland, Ohio

Automatic or semiautomatic welding can bring substantial cost savings to high-volume production operations. The author describes how each process can be used to best advantage and supplies a check list to help determine process selection.

SUBMERGED ARC WELDING by either fully automatic or semiautomatic techniques, *Fig.* 1, is ideally suited to continuous fabrication of metal products in production quantities. Advantages include travel speed three to four times that possible by manual methods at a higher operating factor, full reproducibility, freedom from human error, excellent penetration with edge preparation unnecessary, smooth and ripple-free welds, avoidance of smoke and arc glare, and moderate unit cost. Disadvantages are lack of flexibility and high capital investment, particularly with fully automatic setups.

Tandem Arc: Different types of submerged arc equipment have been developed, some only recently, to permit greater selectivity to match production requirements. The automatic d-c single-arc unit, for example, may be converted readily to a

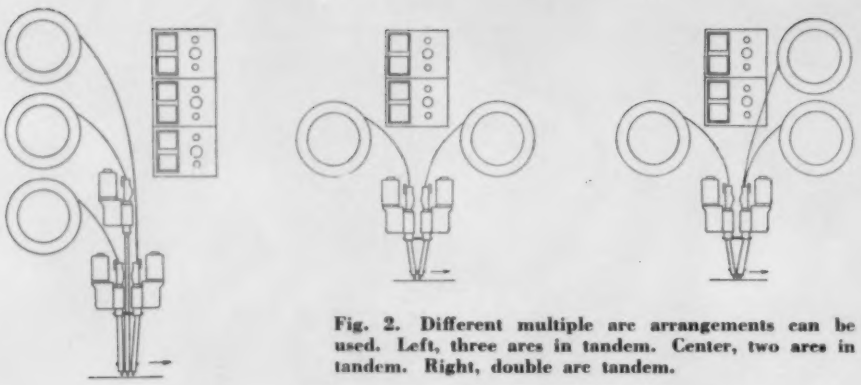


Fig. 2. Different multiple arc arrangements can be used. Left, three arcs in tandem. Center, two arcs in tandem. Right, double arc tandem.

tandem arc by adding an a-c head running about one inch behind the d-c head. The two electrodes are directed independently, but simultaneously, into a common welding crater. Each electrode is fed through its own welding head and uses an independent power source. Still a third head may be added to feed three wires into the weld, further increasing deposition rates, *Fig.* 2. The most important advantage of tandem arc welding is high welding speed and consequent lessening of distortion. Higher speeds mean lower direct labor and overhead costs, facilitating the attainment of production schedules with fewer machines and fewer operators. An even simpler conversion is to adapt a standard head by adding a jaw which feeds two electrodes about $\frac{3}{8}$ inch apart—both powered from the same generator. The double arc is about 50 and tandem 100 percent faster than a single arc.

Two basic types of manufacturing processes are well suited to a tandem arc setup. First, long-run repetitive operations, as in the fabrication of railroad car frames or basic structural beam forms, and second, job-lot operations where the same basic tooling may be used for an assortment of jobs, as in the fabrication of large-size welded pipes and penstocks. All normal types of welded joints which can be made by single submerged arc procedures are adaptable to multiple arc processes, including butt, lap and fillet welds. Procedures have been developed for welding material ranging from 10 gage sheet to six inch and thicker plate. The larger molten crater developed in multiple arc welding sometimes limits roundabout welds to minimum diameters a little larger than those which can be handled successfully with the single arc.

Semiautomatic Welding: Where the higher investment involved in a fully automatic setup cannot be justified, a semiautomatic welding gun, *Fig.* 3, has attractive possibilities. It has somewhat lower travel speed and requires some skill on the part of the operator, but weld quality, consistency and speed are both superior to manual welding.

A recent innovation is "mechanized gun welding," in which a small motor and serrated drive wheel are mounted on the welding gun so that all the operator has to do is to steer the arc along the joint he is welding. Previously the operator had to supply the propulsion effort and guess at his travel speed. The new arrangement combines the precision of full automatic welding at known arc speed rates with the flexibility of manual welding, and at moderate cost for equipment.

With mechanized guns, the arc length (voltage) and current are adjustable, as is the rate of flux supply and travel speed. Three requisites are: the work must be positioned for down hand welding

Fig. 3. A mechanized welding gun provides automatic wire and flux feed, plus travel speed, while manual guidance permits making circular or contoured welds.

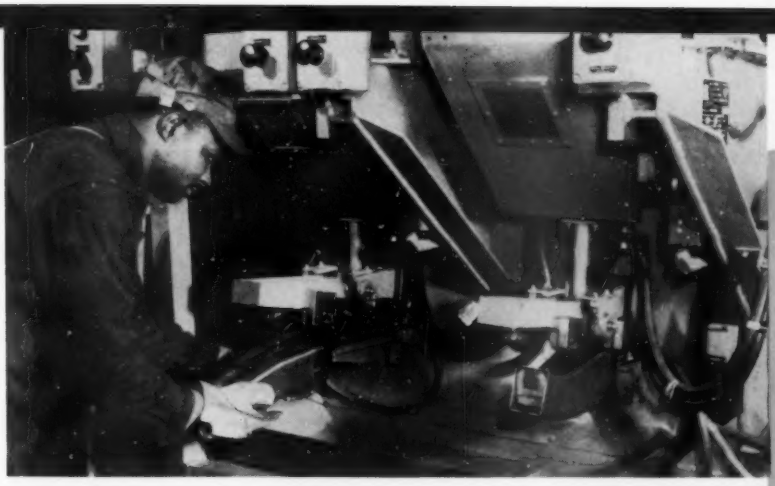


Fig. 4. (left) Two fixtures aid in double-head automatic welding of channel stampings into tubular center frame sections. After a convex weld is made in the left position, the concave portion of the seam is made at the right.

(flat or horizontal); shape of the part should allow movement of the welding gun over the work or moving the work under the gun; and reasonable fitup and joint cleanliness must be maintained. Scarfing or edge preparation is unnecessary.

As an example of comparative welding speeds, a horizontal ¼-inch fillet, laid down manually at 14 ipm and at 40 ipm by fully automatic equipment, can be run at 32 ipm with mechanized semiautomatic welding. It is possible to set up the semiautomatic equipment to be independent of operator manipulation by mounting the gun on a simple fixture and, in the case of circumferential welds, rotating the part under the electrode point mechanically. Manual welding is recommended where:

1. Out-of-position welds are involved, with danger of spilling a large molten metal pool
2. Extremely short welds are to be made
3. Light-gage welding is being done. About 10-gage material is the low limit for semiautomatic applications, although instances are reported of semiautomatic welding on even lighter gages
4. Small, nonrepetitive jobs are being scheduled.

Semiautomatic welding is best suited to these applications:

1. Jobs where advantage can be taken of the increased melting rate at the higher currents used
2. Where continuous wire feed will increase the duty cycle
3. For work that is repetitive enough so that proper procedures and practices can be worked out until the desired operator skill is acquired
4. Where complicated shapes make fixturing for fully automatic welding difficult
5. Where additional penetration is an advantage
6. Where contour and fitup are not accurate enough for fully automatic guiding.

Fully automatic welding should be selected where:

1. Highly repetitive jobs that can be fixtured are being handled, in sufficient quantity to amortize equipment costs in a reasonable period of time
2. Complete automation is desired, since the method provides pushbutton automatic arc striking, heavier equipment construction, higher current capacity and self-contained travel mechanism.

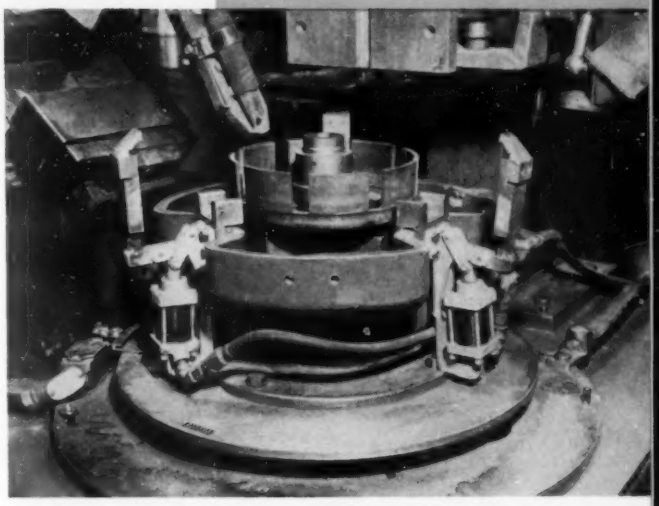


Fig. 5. Air clamping fixtures in this unit hold the assembly while an automatic circumferential fillet weld is made to join a clutch hub to a housing as the two parts are rotated under the welding head.

Tooling: Success and economy of any of the automatic or semiautomatic arc welding processes unquestionably hinge frequently on efficient tooling and fixturing, involving suitable positioning and actuation of either the work or the welding head, or both. Nowhere has this proved more significant than in the automotive industry where unit costs often must be figured to the fourth decimal point. The result has been that tooling and fixturing of welding equipment have been developed to a high degree of refinement. Long and sustained production runs, occasionally running into the millions, have led to the selection of full automatic equipment on most automotive applications.

Representative installations on automotive parts are shown in *Figs.* 4 and 5. They typify the ingenious fixturing found throughout automotive welding operations, aimed at maximum arc time and minimum floor-to-floor time per piece. This offsets the relatively high cost of these equipment and tooling setups.

Many full automatic setups are found in plants

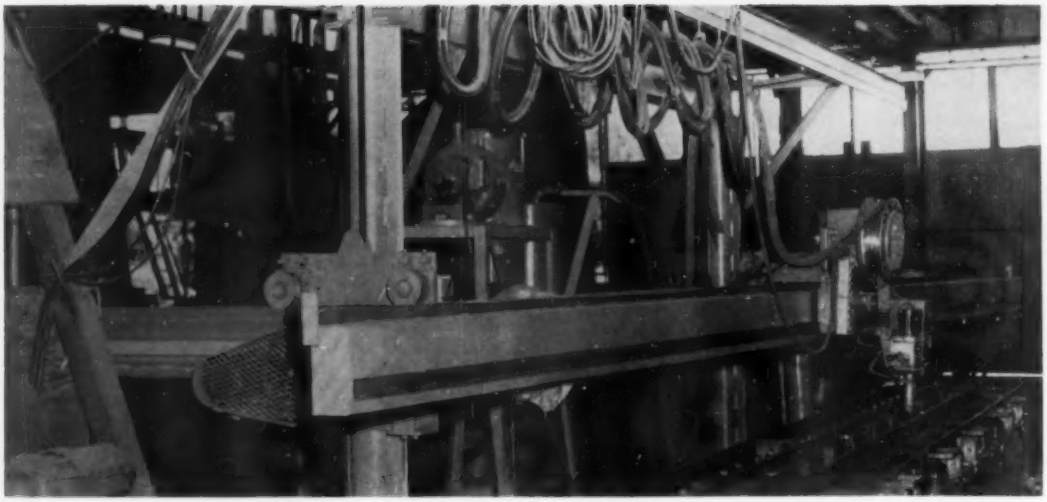


Fig. 6. Boom and hinge construction supporting the rail of this welding manipulator allows the rail to be displaced at an angle of as much as 25½ deg in either direction or total of 51 deg displacement.

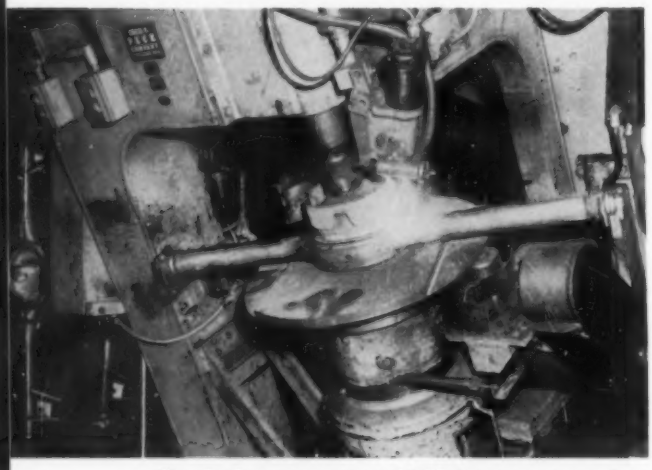


Fig. 7. Open-arc, vapor shielded process is used on this machine to weld banjo axle housings. The 35 inches of weld are made at a speed of 150 ipm. Machine automatically controls "hot start" table rotation, table stopping and arc extinguishing.

other than automotive; fabrication of the large weldment shown in *Fig.* 6, for example. The rail on which the welding head rides can be moved in or out electrically at either end for a maximum angular displacement of 51 deg, permitting a long weld to be made in structural components at an angle to the edges. Air clamping of the pieces to the table holds down distortion, while power rollers on the table speed up loading and unloading.

A few basic guideposts to the design of efficient jigs and fixtures are:

1. The jig must have adequate rigidity to hold dimensions of the weldment
2. The assembly must provide easy locating points
3. It must be possible to clamp and release quickly
4. Loading and unloading must be simple, with minimum manual effort
5. It may be desirable to provide means to precamber the weldment to control distortion of the finished piece
6. Provision of dual jigs will increase productivity, permitting a helper to load one while the other is on the welding cycle
7. Separate jigs for tacking and final welding are often profitable
8. Assembly and clamping should provide the best possible fitup, since the welding of joints with gaps larger than necessary is costly
9. Provisions should be made to insure clean work. Oil, rust and dirt will cause welding difficulties.

Vapor Shield: A comparatively new development in automatic metallic arc welding, designed principally for work on light-gage steel and high production jobs, is the "Inner-shield" process, *Fig.* 7. Instead of a granular flux being deposited over the arc, a vapor-shielded open arc is employed, with all of the welding materials—arc shield, fluxing ingredients, deoxidizers and filler metal—contained in the electrode wire. The wire is tubular, with flux materials and arc shielding chemicals in the core. Arc glare, of course, cannot be avoided. However, flux handling and storage, and the loose flux associated with the submerged arc process, are eliminated. Consistently high-quality welds can be made at speeds of 150-200 inches per minute.

Introduction of alloy-containing fluxes has increased the utility of submerged arc welding equipment, both automatic and semiautomatic. Hard surfacing for both original equipment and maintenance of wearing parts now is possible with minimum operator control, thanks to the new fluxes used with conventional mild steel electrode wire.

the international inch ...what does it mean?

By E. L. Watelet
Supt., Precision Tool & Gage Group
Brown & Sharpe Mfg. Co.
Providence, R. I.

ANNOUNCEMENT by The National Bureau of Standards of a new standard inch will have far-reaching effects on high-precision dimensional measurements. In fact, the value of the inch has been changed after having been in official use since late in the nineteenth century. In 1893 the inch as used in the United States was defined by the Office of Weights and Measures as follows:

1 inch = 25.4000508 millimeters

The inch as used by England and its English speaking colonies, except Canada, was defined as:

1 inch = 25.399956 millimeters

The value of the inch as used and defined by Canada is:

1 inch = 25.400000 millimeters

As a result of these discrepancies—the heads of the various standards laboratories of the United States, United Kingdom, Canada, New Zealand, South Africa and Australia finally agreed upon a standard value of the inch as being:

1 inch = 25.40000 millimeters

The result is that standard lengths have been shortened by about 2 millionths of an inch per inch. The effective date on which all measurements will be made to the new value was July 1, 1959.

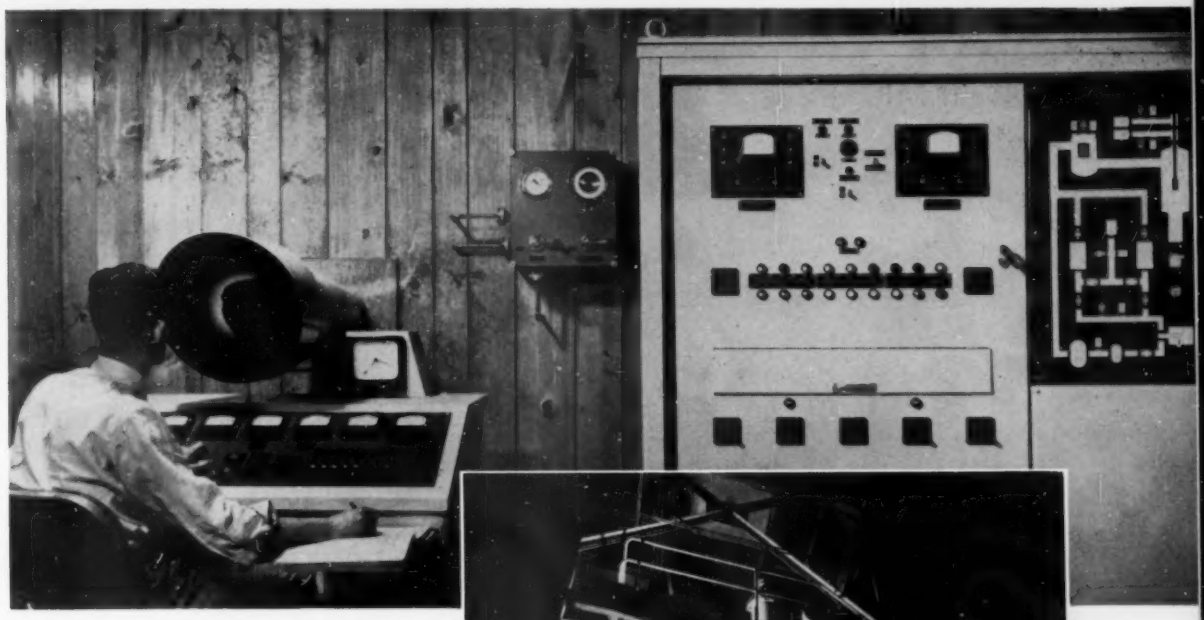
What does this mean to manufacturers? Fortunately—unless a manufacturer is making gage blocks and other length standards, is engaged in the measurement and certification or calibration of length standards, or is in the business of making a product to ultrahigh precision—the change will have little or no effect upon his operations. Normal tolerances in precision manufacture of 0.0001 inch or even 0.00001 inch will not be affected by a difference of two millionths of an inch per inch.

If master calibrated gage blocks are maintained in the inspection or standards department, all that is required is that the calibration of each master be changed by adding 0.000002 inch per inch to the recorded value. Probably gage blocks over 5 inch should be reworked to reduce the difficulties of transferring measurements with precision comparators which have limited range.

Uncalibrated inspection and work sets of gage blocks may, in fact, be in better condition since the increased length of 0.000002 inch per inch provides an added wear factor—or if worn will bring them back to the new standard size. Blocks which previously might have been small will now be nearer standard. Furthermore, since all blocks will now be longer than standard they can be returned for reworking rather than being discarded.

AN OSCILLATING TOOL BLOCK permits two-way planing on a conventional planer at 250 to 300 fpm cutting speed. Planing stepped edges on steel plates prior to welding, the machine cuts a stepped form during the forward stroke and a chamfer on the return stroke. The block turns automatically 13 deg and feeds the tool inward each time the table reverses. Three Kennametal Kendex carbide inserts are used in each block. The machine is at Caterpillar Tractor Co., Decatur, Ill.

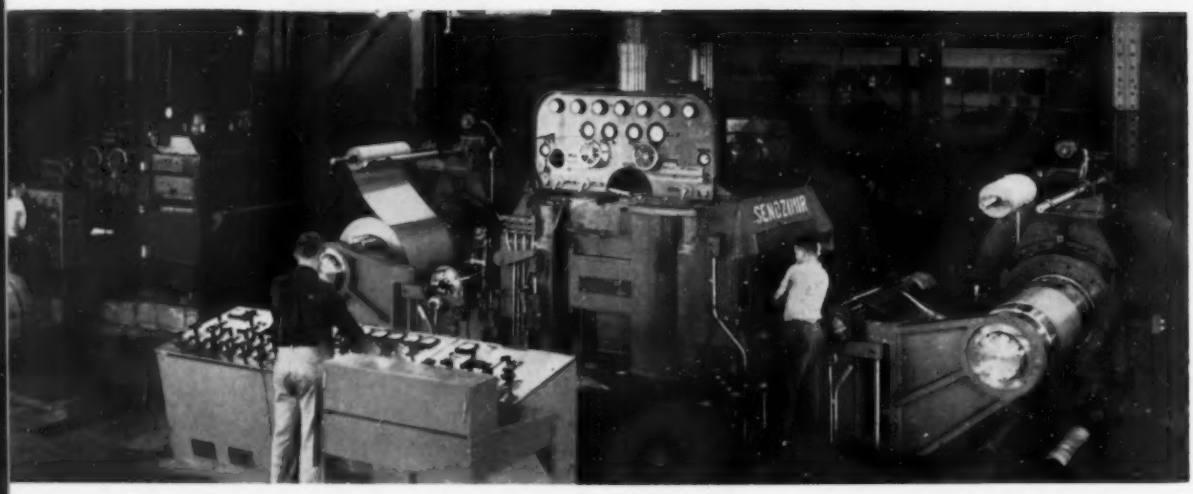
MANUFACTURING ENGINEER checks solder flow device used in manufacture of computers at General Electric Co. Phoenix plant. A flowing fountain of molten solder gives a uniform, dross-free, quality connection. This process eliminates touch-up and improves both productivity and quality over hand or dip soldering. Temperature is easily controlled.



REMOTE OPTICAL VIEWING SYSTEM gives the operator a continuous view of the arc and the molten pool. Vacuum melting and close process control result in steels with improved-performance in service.

CONSUMABLE-electrode vacuum melting furnace is sequenced automatically. Furnace is part of a $3,500,000 expansion at Vanadium-Alloys Steel Co., Latrobe, Pa.

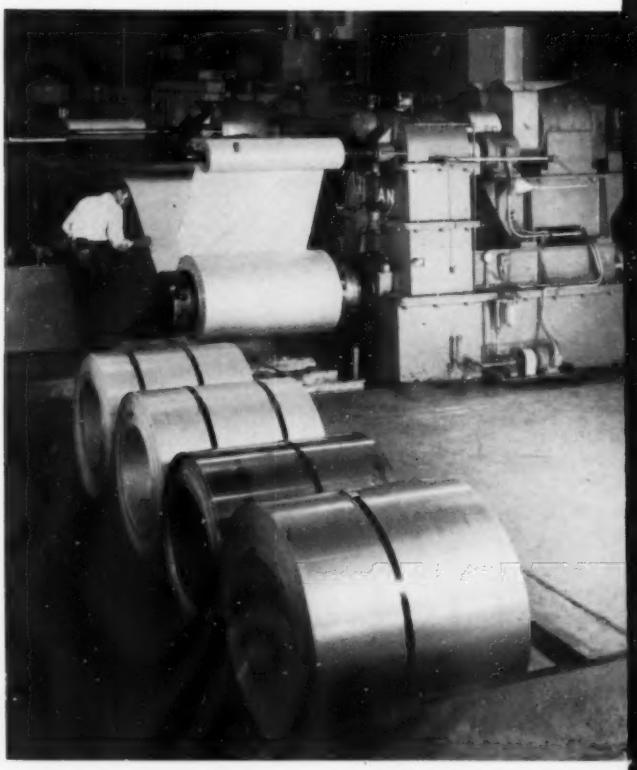
TOOLS at work



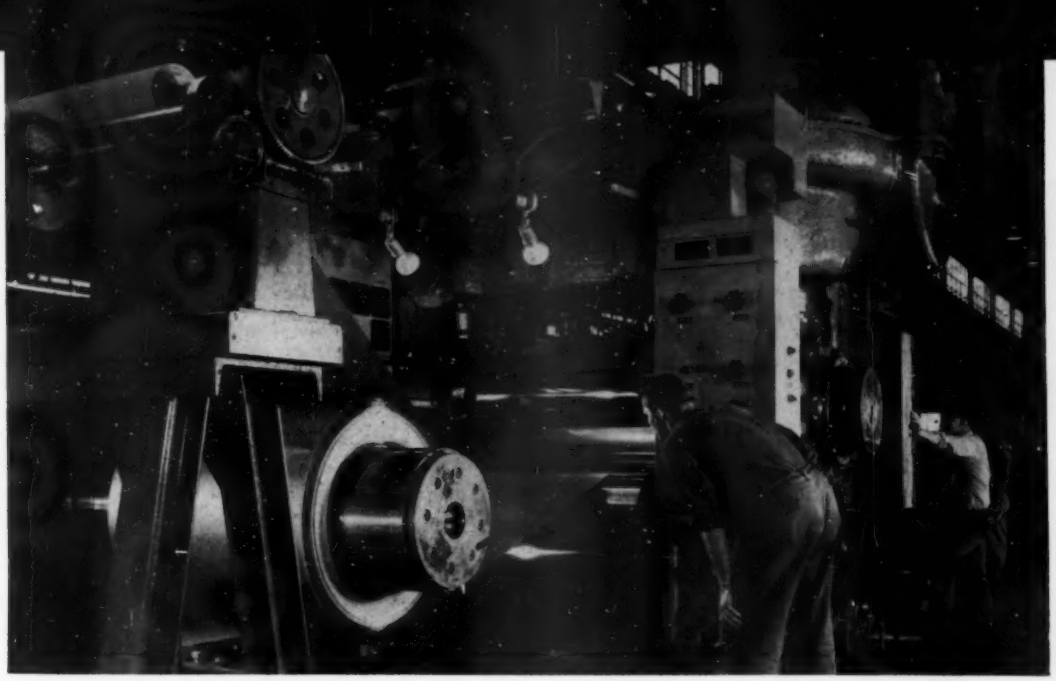
THIS 52-INCH MILL produces stainless sheet and strip to close tolerances in gages down to 0.010 inch at the new sheet and strip mill of Jones & Laughlin, Louisville, Ohio. The operator controls the mill from the console in the foreground.

TOOLS at work

SCOURING AND SCRUBBING LINE helps to maintain superior surface finish on coils of stainless steel at Jones & Laughlin. Material is thoroughly cleaned and superficial blemishes are removed from the surface.



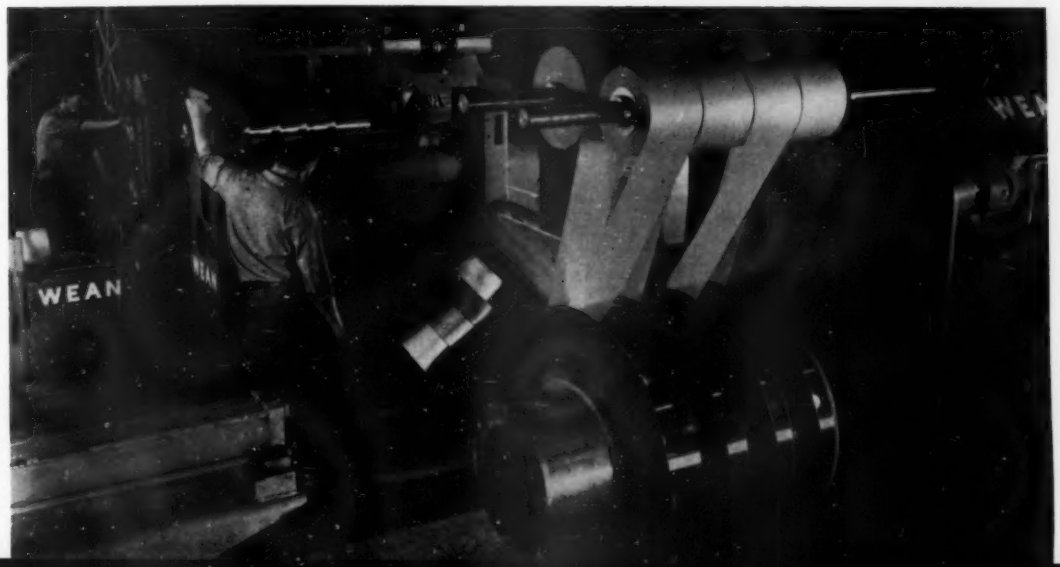
STAINLESS STEEL is inspected after being cold rolled, annealed and pickled at the Jones & Laughlin mill. Annealing removes stresses created by reduction of thickness during rolling. Pickling removes scale, cleans surface of the strip.

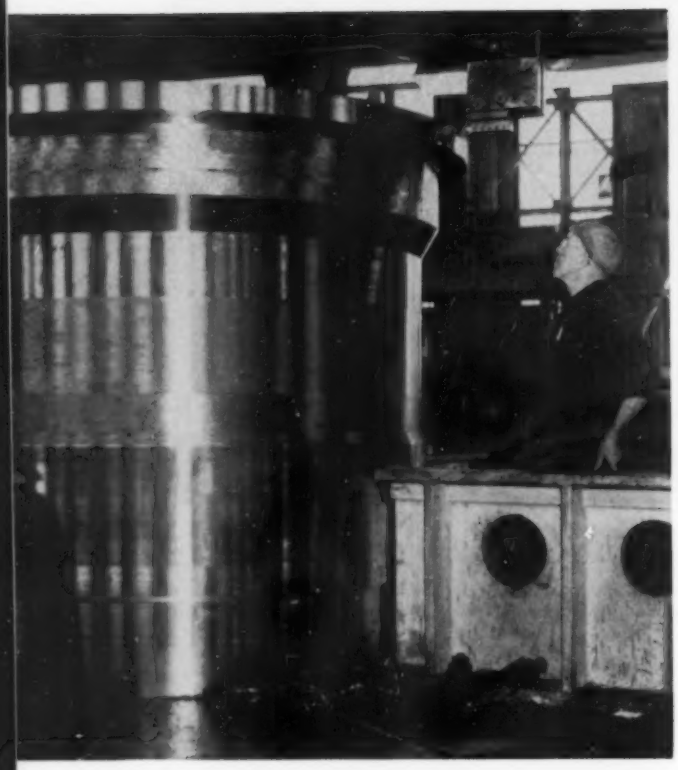


SUPPLEMENTING THE ROLLING MILL is this 54-inch temper mill for stainless steel. Object of this operation is to reproduce the smooth, highly polished surface of the rolls on the stainless material. Paper from roller at upper left is inserted between the surfaces of the material to protect finish. Capacity at the Jones & Laughlin plant is 36,000 tons of flat rolled stainless steel per year.

AFTER FINAL COLD ROLLING, coils are cut into sheet length, stacked for shipment or subsequent polishing operations. Operator at console controls entire operation. Manual handling during stacking minimizes damage to thin sheets. Handlers perform visual check.

THIS 50-INCH SLITTER is one of three lines for cutting coil into strip widths at the Jones & Laughlin mill. Slitting is performed on a continuous basis. After coils are wound, they are transferred to storage areas by mechanical handling equipment.

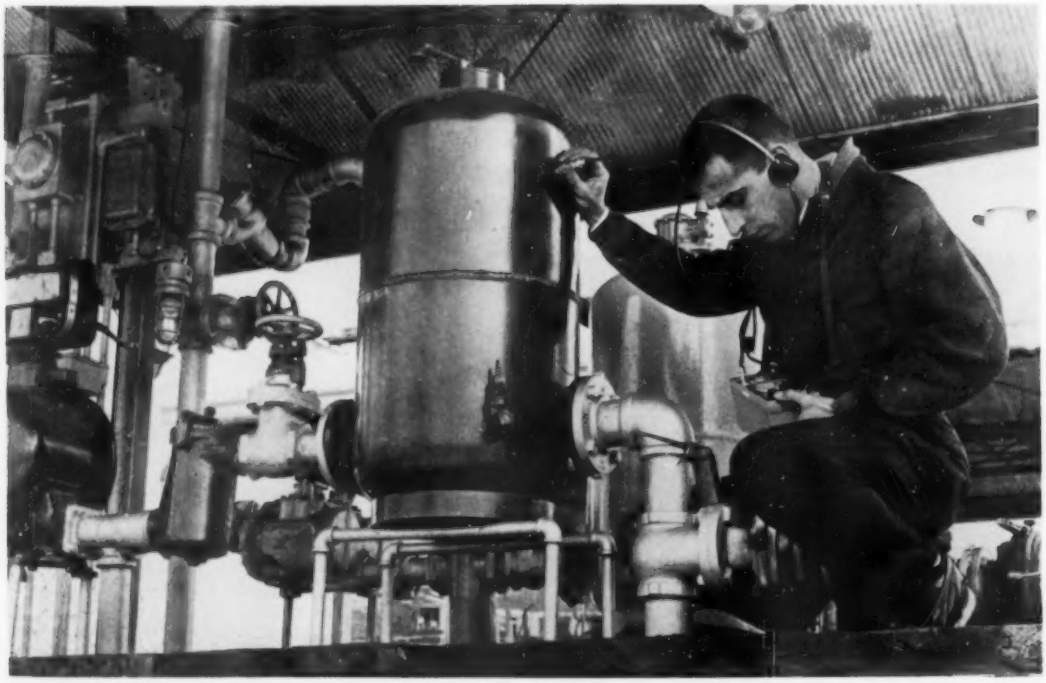




THROWAWAY CARBIDE INSERTS are used for machining this stainless-steel casting on a 20-foot boring mill at Baldwin-Lima-Hamilton Corp. Tool edge life, formerly 30 minutes on the rough scale surface and an hour on the bare metal, was increased to one hour and three hours respectively. Four cutting edges, which can be indexed without adjustments to the machine, give up to four hours of continuous cutting on the scaly surface and 12 hours on the bare metal without regrinding. Machining feed and speed, formerly 0.030 ipr and 89 fpm with high-speed steel and brazed-tip tools, were changed to 0.015 ipr and 150 fpm. Tools for this job on 304 stainless steel are now positive rake with Grade K6 Kennametal throwaway carbide inserts.

TOOLS at work

PORTABLE ULTRASONIC THICKNESS TESTER is used to check walls of vessels subject to corrosion. When a high-sensitivity ceramic transducer is applied to the material under test, harmonic resonances are indicated by deflection on a small dial. Simultaneous computation and conversion of these resonant frequencies is registered on a panel meter. The instrument weighs less than five pounds and is made by Branson Instruments, Inc., Stamford, Conn.



cutting hard materials with ceramics

By D. T. Biseeglia and J. W. Rodd

Research Engineering Div.
Industrial Processes Branch
Watervliet Arsenal
Watervliet, N. Y.

Ceramic tools are being successfully used to rough, semifinish and finish turn high-strength alloy steels. All essential operating data are given by the authors, who describe production tests.

IMPROVEMENTS IN PRODUCT DESIGN often cause new manufacturing problems. Modern high-velocity guns, for example, are considerably lighter in weight than their predecessors. Structural materials, however, are harder and tougher in order to withstand the internal pressures required of high-velocity weapons. Sintered carbide cutting tools are stressed to the maximum in machining the newer alloy steels. In 1954, a 90 mm gun could be successfully machined at 300 fpm. With today's harder materials, machining speeds are 180 fpm or lower.

Ceramic cutting tools are unquestionably an answer to machining these hard materials. Laboratory tests show that while running at speeds of 700 fpm and above, ceramic tools perform successfully. They give good tool life on long workpieces such as gun tubes, where tool wear resistance is a prime factor in size control. Also, the fact that ceramic tools are made from common elements is an important defense consideration.

The feasibility of using ceramic tool materials was proved by a series of machining tests at Watervliet Arsenal, followed by pilot-line testing on forged gun tubes, *Fig.* 1. The rough steel forging is 24 feet long and varies from 8 to 11⅝ inches in diameter. The material is a modified 4340 formula with a 180,000-psi tensile strength and is noted for its difficult-to-machine characteristics. This steel is hardened and drawn to 34-42 R_C with occasional hard spots of 45-48R_C. Average life for a premium grade of carbide during rough turning is approximately 130 linear inches with a speed of 150-180 fpm and a feed of 0.022 ipr. Volumetric stock removal is an average of one cubic inch per minute.

Ceramic tooling applied to the same operation has an average life of approximately 300 linear inches at speeds of 380 rpm and 0.017-0.020 ipr feeds. Stock removal is two cubic inches per minute.

Toolholders: Satisfactory performation of ceramic cutters is strongly dependent on the holders used. In all tests, and in actual pilot-line operations, standard, heavy-duty mechanical toolholders were employed, *Fig.* 2. These were modified to utilize carbide backup plates and serrated adjustable chip breakers. This proved adequate for external machining operations where negative tool geometry could be applied and is an advantage in testing ceramic materials. Dynamometer studies show that feed forces are quite similar when using either positive or negative rakes, i.e., when not exceeding a two-degree back rake. In all tests positive tool geometries had disadvantages.

The mechanical holder used offers greatest support to the tip since negative angles can be readily obtained and the mechanical chip breaker can be arranged to distribute clamping forces equally. In order to arrive at optimum tool life, several toolholders were designed and tested. As a result of the tests, several conclusions were drawn:

1. The holder should be a mechanical clamp, heavy-duty type. Despite the fact that cemented tips do perform satisfactorily in many applications and great progress has been made in bonding processes,

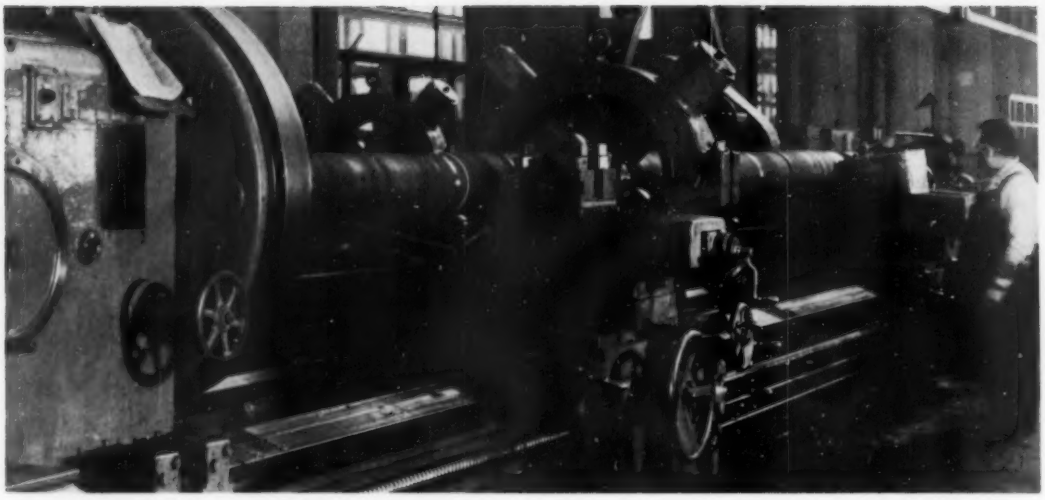


Fig. 1. (above) Setup for machining 120 mm gun tubes with ceramics. Although the lathe is an older model, it is massive and well-ribbed, affording good rigidity. Large chuck at left acts as a flywheel.

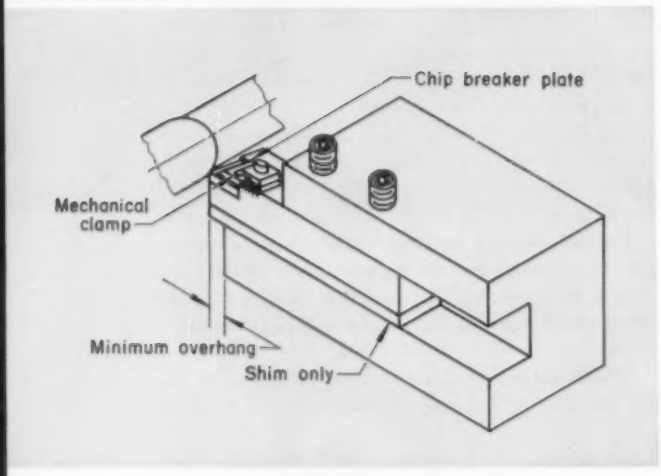


Fig. 2. (left) This type of toolholder gave best results when machining high-alloy steels with ceramics.

the only acceptable method for fastening tips to be used for cutting high-strength steel is mechanical clamping against a carbide anvil.

2. Tool projection or overhang of the tip holder should be kept to a minimum. Where possible, it is recommended that the tangential cutting force approximate a straight line to the compound ways.
3. Rockers or semicircular adjusting bases should not be used for establishing tip height. Only solid shims are recommended for this purpose, or preferably, the tool thickness selected should be sufficient to eliminate the need of adjustment.
4. The chip breaker plate must be carbide. Although hardened steel may be used for brief periods, the short life of materials other than carbide makes them impractical. The interface of breaker and rake surface must be a tight, continuous fit and press evenly across the maximum area of contact. Only breaker fasteners that effect these conditions are recommended.

Depth of cut on cannon tubes varies—in any one cut—from ¼ to ⅝ inch, due to the eccentric distribution of the rough stock. This condition is probably the most severe stress the shock-resistant ceramic material must survive and it is the condition that initially presented the greatest problem during testing. A partial solution to this problem was accomplished by inserting a shim cushion of aluminum foil, 0.0015 inch thick, between the ceramic tip and the carbide seat of the tool holder. The function of the foil is to compensate for interface surface irregularities and to provide a greater contact area between the faces.

Cutting Conditions: Early tests with ceramics showed rapid failure when cutting high-alloy steel, even when run below speeds common to tungsten carbide. This difficulty was overcome by using a variation in negative tool geometry and directing the cutting forces to the center of the tool shank, thus putting the tip in compression. The test setup is shown in *Fig.* 3. Most successful results were obtained with the following:

Scale removal: 180-380 fpm. 0.014-0.019 ipr feed
Roughing: 190-380 fpm speed, 0.014-0.017 ipr feed
Finishing: 320-550 fpm speed, 0.005-0.008 ipr feed
Lead angle: 15 to 45 deg, depending on depth of cut
Tip: ¾ x ¾ x ¼ inch
Holder: negative side rake, 7 deg; negative back rake, 7 deg
Nose radii: 0.062 inch
Chip breaker: approximately eight times feed rate.

The tests showed that when machining scale or out-of-round workpieces, the lead angle should be

advanced between 30 and 45 deg and the speed should be reduced to eliminate possible chatter due to increase chip width. The ceramic tip should not be allowed to dwell in the cut since this procedure has a tendency to cause severe chipping and creates a work-hardened surface that is detrimental to subsequent machining.

Chipping of the leading edge did take place in some instances. At least a portion of this was caused by the failure of the mechanical chip breaker to curl the chip properly. With this exception, successful results were achieved in machining noninterrupted roughing, semifinishing and finishing cuts. All tips exposed to interrupted cutting of high-strength steel failed rapidly.

Tool Material: High-speed machining (above 600 fpm) conducted in the laboratory showed that the ceramic material, which is a relatively pure aluminum oxide having a density approaching a pure crystal with no affinity for metal, resists build-up or tip welding. Also, since the material has relatively high compressive strength, it exhibits extreme resistance to loss of strength and hardness at elevated temperatures. Ceramic tips maintained their hardness at temperatures visually estimated as being in excess of 1500 F. Tool wear was comparable to that encountered at lower temperatures.

Physical properties of the ceramic cutting tool material that proved most successful during the extended series of tests are:

Density: 3.99 g per cc
Modulus of elasticity: 50,000,000 psi
Modulus of rupture: 65,000 psi over 9/16-inch square
Compressive strength: 400,000 psi
Thermal coefficient of linear expansion: 8.0×10^{-6}
Coefficient of friction on steel: 0.17
Knoop hardness (k 100): 2000
Melting point: 2000 C (starts to soften at 1800 C)
Thermal conductivity: 35 Btu/hr/sq ft/inch/deg F at 2000 F

Microstructure approached theoretical density.

Tool Tips: Use of insert type tips, *Fig.* 4, limits regrinding problems. Grinding the 30-deg negative land angle is, however, recommended. A resinoid-bond diamond-impregnated wheel of at least 220 grit should be used with a light feeding pressure, holding feed to not more than 0.001-inch, preferably less. A circle-generating fixture, *Fig.* 5, is used to grind tip radii. Use of this type of fixture eliminates the need for form-dressing the corner radius in the diamond wheel, which is an expensive and time-consuming procedure.

Grinding should be followed by hand honing to eliminate grinding lines or notches. Heavy hand honing of the tip area that is not engaged in the cut improves tool life and prevents premature tool failure caused by edge chipping resulting from chip contact. Where cyclic loading of the tip occurs, as when the depth of cut varies to a great extent, heavy hand honing should extend the full length of the tip cutting edge.

During the tests, an interesting phenomenon was noted. On machining a selected number of pieces or a definite linear length, the ceramic tip and holder were removed from the machine and set aside. Another holder and tip were then placed in the machine and the operation resumed to the same point of completion as the previous one. By alternating holders and tip indexing, tool life was increased to a remarkable degree. Ceramic tips that were indexed upon the appearance of wear and were not alternated showed rapid failure, to the ex-

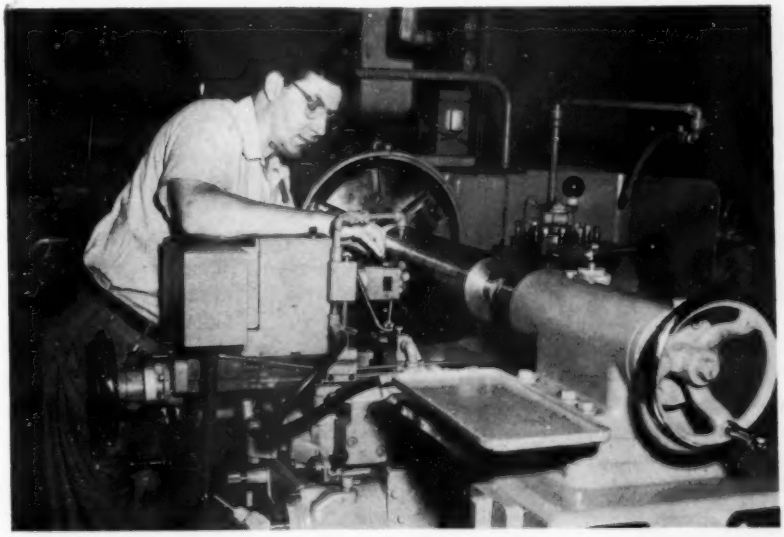


Fig. 3. Preliminary tests were conducted on this setup, using solid logs. Dynamometer measures machining forces.

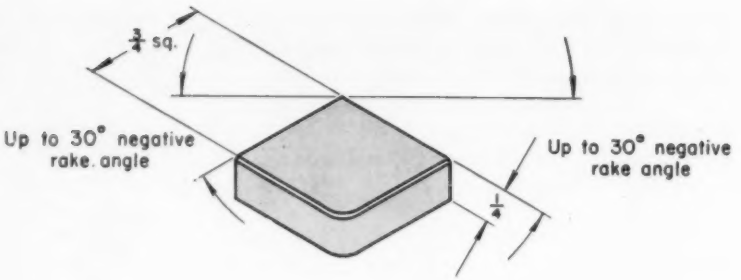
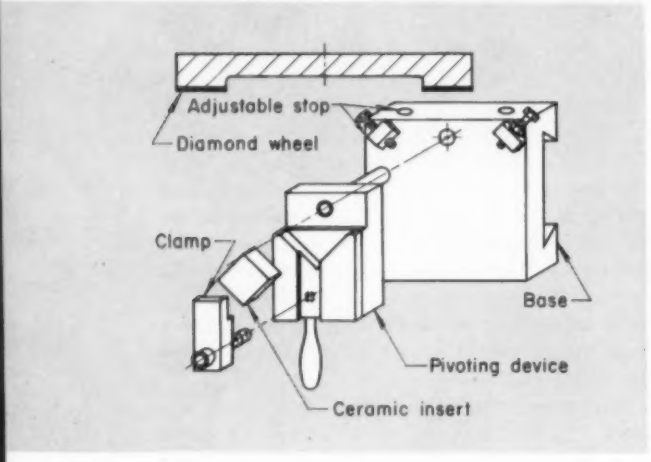


Fig. 4. (right) Insert type ceramic tip requires minimum regrinding.

Fig. 5. (below) Circle-generating fixture for grinding radii of ceramic tips.



tent that the tip was severely damaged and could no longer be used. Heat induced through metal shear and chip pile-up apparently has a definite effect on tip clamping pressure.

Pilot-Line Application: Horsepower capabilities are critical factors in the employment of ceramic tooling. Machining of 120 mm gun tubes requires a lathe capable of removing stock at 50 cu in per minute or more. About 50 horsepower are required to cut high-alloy steel at this rate.

The LeBond engine lathe shown in *Fig.* 1 was selected for the tests. This machine could hardly be considered ideal from the viewpoint of drive and train since it is a 1942 model with a long service record. The inherent stability resulting from rotating the 47-inch diameter, 2000-lb drive chuck and the heavy cylinder mass of the gun tube compensated for machine deficiencies. No modification was necessary to use ceramic tooling.

One of the difficulties in turning long workpieces is caused by the deflection of the workpiece when its temperature—and consequently its length—is increased by the cutting action. This effect is drastically reduced with ceramic tooling. Instead of greater linear expansion, which might be expected at the higher cutting rates used with ceramics, the characteristic tendency is for heat to be transmitted into the chip, rather than the workpiece or toolholder. Deflection problems were virtually nonexistent during the pilot-line tests.

It was previously necessary to continually adjust the centers and steady rest throughout turning operations when a carbide cutter was used. With ceramic tooling it is possible to complete the turning of a barrel with only the initial adjustment at loading. And, of course, a corallary to this effect is the reduced maintenance on centers and roller rests.

Conclusions: The problems encountered in applying ceramic tooling are similar to those of the early days of carbide. During the past four years, ceramic tool manufacturers have made great strides in the development of this material. However, some ceramic tips tested varied considerably. One tip would perform satisfactorily, removing a considerable volume of metal, while another tip from the same lot would fail immediately.

At the present time, the cost of ceramic is about two and one-half times that of commercially ground carbide tips. If the mortality of the ceramic tips is high, this expense may offset any financial advantage gained by the increased volumetric metal removal rate. When precision-ground carbide is necessary for a turning operation, the relative costs are about equal. Although the total failure may still occur more frequently with ceramics than with carbides, the frequency of failure can be held to a negligible amount.

At the present time, each application of ceramic tooling must be individually engineered, due to the various conditions that affect performance. When it has been determined that the application of ceramic tooling is feasible, the production machine should be of adequate horsepower and rigidity to sustain the high energy requirements. For maximum safety of the operator and equipment, the machine should be equipped with remote controls and automatic halting devices. Also, chip removal facilities with sufficient capacity to cope with large volumes of chips should be provided. With adequate horsepower and under controlled conditions, ceramics permit higher metal-removal rates than any of the other cutting tool materials available.

determining effectiveness of

DRAWING LUBRICANTS

By Donald F. Eary*

Supervisor of Die Engineering Design
Production Engineering Dept.
General Motors Institute
Flint, Mich.

Means are available to the experimenter to simplify techniques and make results of experiments more meaningful. One of these is statistical analysis. The author illustrates how statistics can be used in tooling experiments by application to determine procedure and evaluate results of an actual experiment.

EXPERIMENTATION to determine characteristics of tooling materials and operations can pay off in lower tooling costs, increased production, better quality products or simplified methods. Anything that decreases the risk of experimental results or the time required to obtain them is a valuable aid to the experimenter. Statistical analysis can do both of these things. By applying statistical methods to experimental data, the validity of such data can be predicted within any confidence limit required. Also statistical methods can be used to determine when sufficient experimental data has been accumulated, thus helping to avoid excessive effort.

The principles of statistical analysis can be applied to almost any experimental endeavor. Only a knowledge of basic mathematics is required. How statistical methods can be applied to experimental work is illustrated by a study of the effectiveness of press drawing lubricants during a cupping operation performed on sheet steel.

Abstracted from Paper 190 "Tooling Experiments Using Statistics," presented at the 27th Annual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

***Senior member ASTE Saginaw Valley chapter.**

Criteria

Variables must first be identified and the proper ones selected to determine the criteria for experimentation. In the case of drawing lubricants, variation of friction is the effect to be measured. The criteria for measuring the magnitude of friction are punch force, cup wall thickness, die temperature and cup surface finish. The major variable is, of course, the lubricant. All other variables remain essentially constant.

Several punch forces could be measured to indicate a change of friction force. These forces are exerted by the ram, die and punch. Because of the large cross section involved, friction of the ram in the guideways, blank holding force and weight, the ram force would be difficult to measure accurately. Hence, it cannot be used in the criteria.

The force exerted by the die opposes the forces of the blank holder and the punch. To find the drawing or punch force, the blank holding force must be determined and deducted from the die force. Obviously, inaccuracies can result.

The punch force can be measured directly. The punch has a relatively small cross section and thereby is more responsive to friction force changes. Thus the punch force is used in the criteria.

For measuring variation of friction forces wall thickness is the characteristic easiest to determine and should give accurate results. Several positions on the cup wall were selected for measurement to indicate both thickening and thinning of the wall.

The measurement of die ring temperature to indicate variation in friction was used for two reasons.

First, greatest relative movement occurs between sheet metal, blank holder and die ring. Second, the die ring has less mass than the blank holder; therefore, the same quantity of heat generated by friction causes a greater temperature rise in the die ring than in other parts of the die.

A failure of the lubricant causes cold welding of the soft sheet metal to the hardened steel die. Galling and scoring result. Scoring is occasionally

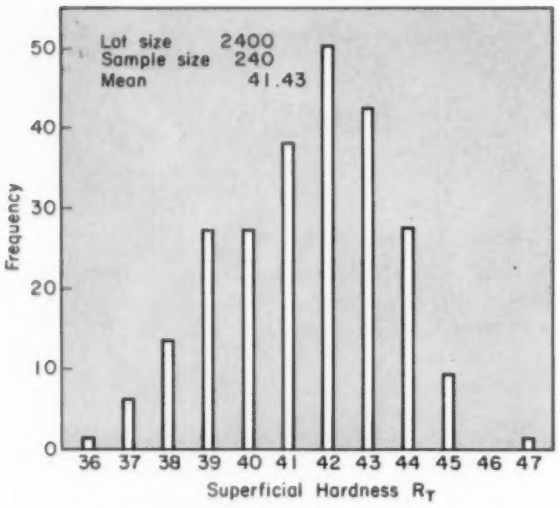


Fig. 1. Histogram for blank hardness. The bell shape indicates random distribution.

caused by dirt or chips on the die, so surface finish is considered to be a relatively unreliable means of measuring friction variation.

Materials and Tools

All materials and tools for an experiment are selected to enhance accuracy. Eleven lubricants were chosen for testing. Protective oil applied to the sheet metal at the steel mill was included as a twelfth. All the lubricants are in current use in metalworking. Their use largely resulted from trial and error. The lubricants selected were:

Mill oil	Molybdenum disulfide
Wet soap	Lard oil
Wet wax	Pigmented medium
Dry wax	Chlorinated wax
Plastics	Heavy oil
Reclaimed oil	Graphite

Sheet Metal: Cold-rolled mild carbon steel, since it is in common use, was selected for this experiment. To control the hardness, all of the sheet metal that was used was cut from a single coil. This assured relatively uniform chemical and physical properties. A thickness of 0.041 inch was selected.

Draw Die and Press: A draw die which made cups 2.560 inches in diameter was used. This die was inverted to have the punch and blank holder on the lower shoe. This was necessary to use the air cushion in the press bed to give blank holding pressure. To obtain a severe test of the lubricants, a large percent reduction and small die radius were used. The theoretical maximum reduction on the first draw is fifty percent. Calculated blank holding force is 2.6 tons. Die clearance was 0.057 inch. Punch radius and die radius were $\frac{3}{16}$ inch and $\frac{1}{16}$ inch respectively. Die steel was 46M oil hardening.

A 75-ton press of suitable shut height was available. This press is of the open back inclinable type with a variable speed drive. The calculated drawing force was 7.2 tons. Although a variable cycle was available. the press manufacturer recommends that continuous press operation be at least 40 strokes per minute. This minimum operating speed was used for the experiment.

Measuring Equipment: Electrical resistance strain gages were selected for force measurement. These gages gave the desired accuracy and sensitivity. The smallest paperbacked gages were used.

A Sanborn multichannel recorder was used to measure and amplify the strain. Thus, a permanent record was obtained on graph tape.

A hand pyrometer was chosen to measure die temperature. This pyrometer gives almost instantaneous readings; therefore, the die would not cool down before a reading was taken. A flexible extension cable facilitated getting the probe into the die. Accuracy was $\pm$ 4½ percent of full scale. A ball-anvil deep throat micrometer was used for cup wall measurement.

Brush: Several methods are used for application of lubricants for drawing including brushing, spraying, wiping, rolling and dipping. Brushing was considered the most practical for this experiment. Both sides of the blank were brushed. Lubricant was not applied to the die. Spraying is useful only with thinner lubricants. Rolling will give the most consistent results.

The selection of materials and tools has a definite effect on how well certain variables are held to nearly constant. Also the cost of the experiment may be determined by these selections.

Controlling Variables

Certain variables must be held nearly constant for an experiment so that other variables may be measured. After the major variable, the lubricant, and the criteria variables are determined, the other variables must be analyzed to see how well they

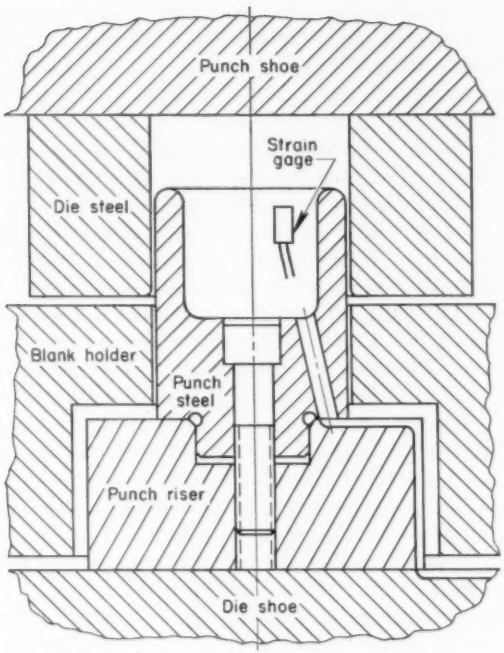


Fig. 2. Detail of punch and die. By mounting the punch on the lower shoe gage leads are not flexed.

are controlled. These variables may be divided into three groups as follows:

Type A: Variables that are controlled so that they may be considered to be constants

Type B: Variables too difficult to control that must be randomly entered into the experiment

Type C: Variables too difficult to control that must be presorted to prevent distorted results.

These variables are analyzed using statistical methods whenever possible.

Type A Variables: The variables which were controlled to the greatest degree and the means used for control are as follows: the drawing speed was regulated by electronic control of press cycle time. By having an unheated blank and die, the factor of drawing temperature was held nearly constant at room temperature. The percent reduction was controlled by using constant blank and draw punch diameters. The die surface finish was controlled by using hardened and ground tool steel for the punch, die and blank holder. A pressure gage in the air line to the cushion enabled the blank holding force to be accurately controlled.

Type B Variables: The B and C type variables occur mostly in the sheet metal because of production tolerances. Because of greater variation, the sheet metal should be tested with statistics; otherwise, this variation could affect measurement of the criteria variables and the true effect of the lubricant variable would not be found. The sheet metal variables to be measured were hardness, tensile strength with grain, tensile strength across grain, elongation with grain, elongation across grain, surface finish, and thickness. After 2400 pieces had been blanked, 240 blanks were randomly selected and tested for hardness. This sample represents the hardness variation within the total lot. The hardnesses were then plotted on a histogram as shown in *Fig.* 1. A histogram shows the frequency with which data values occur. Data is not recorded directly on a histogram —it must be first divided into cells which represent ranges of data values. There should be from ten to twenty cells on a histogram. Use of cells simplifies calculations, condenses data and makes the histogram easier to plot and read. Cell size is determined by observing the total range or variation of the data and dividing this range into equal cells.

If the data has been collected with all variables occurring randomly, the histogram takes the form of a bell-shaped curve. A perfect shape is never obtained in practice, but an approach to a bell shape insures that the experiment has been correctly designed and the effects of the desired variable are truly represented.

The hardness histogram approaches a bell-shaped curve. This means that a normal distribution exists. As long as the blanks are randomly used in the experiment, the hardness will not affect measured data. This is only true when a sufficient sample size is used.

Tensile tests were conducted to find the ultimate strength, percent elongation and the variations of each. Specimens were cut both with and across the direction of rolling. Since rolling can cause a severe fiber condition, it was desirable to know if signifi-

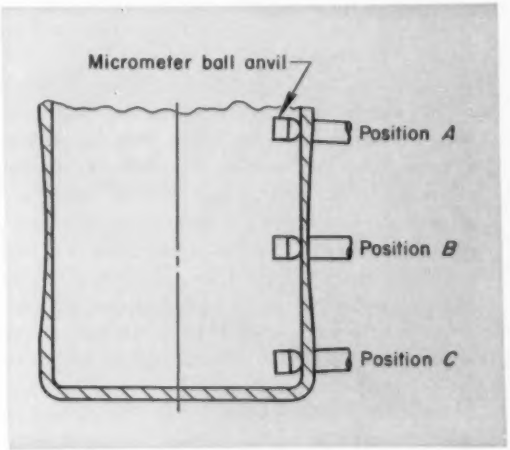


Fig. 3. Only readings taken at position *C* gave accurate measurements of wall thickness. At position *A*, a slight shift of the micrometer causes a sharp change in reading; *B* readings are inconsistent.

cant differences were caused in tensile strength and elongation by the direction of rolling.

Histograms were plotted for force and elongation data. They were compared by computing the means and deviations. The arithmetical average of all the data is called the mean. The mean is calculated using frequencies, sample size and cell size. The variation of data from the mean is called deviation. It does not represent the full variation of data but is used as a measure of the quantities of data under various sections of the histogram curve. The deviation is calculated using sample size, frequencies, number of cells and cell size. Deviation may be found as portions of the cells or in original units as shown in the collected data.

A five percent level of risk was selected for this experiment. The level of risk represents the percent of data falling outside selected deviation limits. The most common level in use in industrial work is five percent. The level is selected usually on the basis of economics.

The means, deviations and sample sizes are used to compute a probability factor. This factor is used with a table to find the significance of difference between means. When the computed factor is greater than the table factor, then the probability is less than five percent that the difference occurs due to chance. A significant difference between means does exist. When the computed factor is less than the table factor, then the probability is greater than five percent that the difference occurs due to chance. A significant difference between means does not exist. The table factor simply gives the value of probability that exists under normal conditions for the means, deviations and sample sizes analyzed.

A similar procedure is followed to determine the significance of difference between deviations. The statistical test for difference of deviations is referred to as the test for homogeneity. If a significant difference between deviations does not exist, they are said to be homogeneous.

It was found that a significant difference in tensile strength due to direction of rolling does not exist. Therefore the direction of rolling does not have to be considered when locating the blanks in the die.

The tensile strength and elongation histograms approached a bell-shaped curve. If the blanks are randomly selected, these characteristics will not affect measurement of variables. The histogram for elongation across the grain indicated that the sample should have been larger. The tensile force deviations were homogeneous. The elongation deviations were not homogeneous.

Sheet metal surface finish varies due to surface finish of rollers, speed of rolling, temperature of rolling and the reduction made at the various passes. Surface finish measurements were made with a brush surface analyzer pickup. Root-mean-square meter readings in microinches were found for eighty randomly selected blanks. When the data was put into histogram form, a bell-shaped curve showed a normal distribution.

Type C Variables: The thickness of the sheet metal represents a type C variable. The thicknesses of 240 blanks were selected at random and measured with hand micrometers. In this case a bell-shaped curve did not result. Even though the blanks were used randomly, errors could result.

Due to the wide range of thicknesses, it was suspected that a sizable drawing force error might result. Therefore, the drawing force was calculated for the minimum and maximum thicknesses encountered. An error of ± 6.9 percent from the mean drawing force could exist. Since this error would cause incorrect measurement of the reduction of the force due to friction, a means of factoring the thickness variable out was devised.

The blanks were sorted by thickness into ten categories. The blanks were then divided equally among the twelve lubricants to be tested. Each sample of 200 blanks for each lubricant had an identical number of blanks of each thickness. Therefore, no lubricant had any advantage due to variations in blank thickness.

Design Experiment

The details of the experiment could now be planned. These include mounting the gage, calibration, data forms and procedures. A hollow punch was used for this experiment. There are two

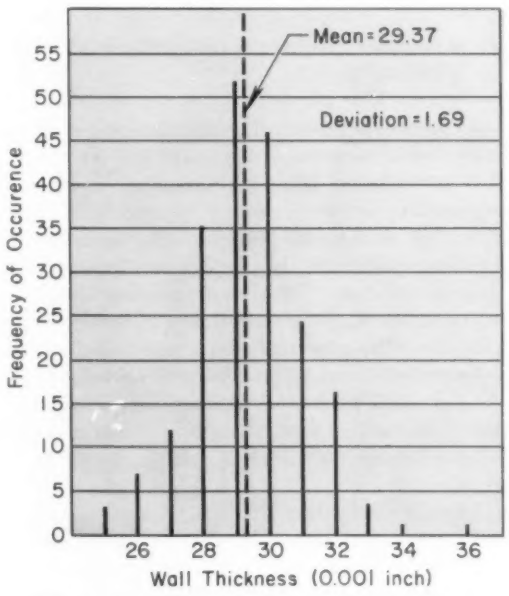


Fig. 4. Wall thickness histogram, lubricant *D*.

main reasons for using a hollow punch. First, the cross-sectional area in compression is smaller than in a solid punch. Thus the strain is greaetr and more readily measured. Second, the hollow punch permits mounting the strain gage close to the end of the punch. The punch exerts its force where the bottom radius and side of the cup blend together at the tangent point. Hollowing out the punch end has no effect on the contour of cup produced.

Due to clearances in the die, placement of the strain gage in other parts of the die would have been difficult. A cross-sectional view of the die is shown in *Fig.* 2. A groove is cut in the punch riser and die shoe to carry the leads out of the die. A slanted hole in the punch steel carries the leads through to the groove. This method was necessary to prevent the blank holder from cutting or mashing the leads. Melted beeswax was poured into the hollow punch steel to protect the strain gages and leads from moisture and lubricants.

The advantages of having the punch on the lower shoe are apparent. The strain gage leads are not flexed with each die closing. This motion could cause errors in strain measurement. Also the repeated flexing could break the leads. The punch was calibrated directly by loading in a hydraulic press and recording values. Without actual calibration, the modulus of elasticity for the punch steel would have to be estimated and the strain calculated, possibly resulting in errors.

Sample Size: Actually, it was impractical to determine an exact sample size since the expected variation in readings was not known. The sample size was set at 200 cups to be made per lubricant tested. Cost and time permitted such a large sample, but a sample of fifty or one hundred would have been sufficient to give a complete histogram.

When continual breakage or scoring of cups occurs in one sample for a particular lubricant, the experiment should be halted for that sample. Thus all 200 blanks were not run for each lubricant. Cup damage would indicate failure of the lubricant without measuring the reduction in punch force or thinning of the side wall.

Sequence of Testing: To reduce the effects of sequence of testing lubricants, the sample of 200 was divided into four subsamples of fifty each. By doing this, randomness was introduced into the sequence. Each lubricant could follow any other of the twelve lubricants. The lubricant was to be thoroughly cleaned from the die before the next lubricant was tested. However, some lubricants are very difficult to remove and traces could be left in the die. Therefore, the next lubricant would have either an advantage or disadvantage because of these traces. Random testing sequence would reduce this effect to a minimum. To introduce randomness, a table of random numbers was used. Each lubricant was assigned a number from one to twelve. The appearance of numbers in the random table then determined the sequence of testing.

Code Letters: Often the experimenter or his assistants have a favoritism for one or more of the lubricants. This bias could tend to sway their actions in running the experiment and possibly result in errors. To reduce the effects of bias, code letters are assigned to the lubricants. All data sheets are marked by code letters. The complete analysis of data is made with the code and when conclusions are made, the code may be translated.

Data Forms: Forms should be designed and printed prior to running the experiment. The experiment runs smoothly and accurate recording of data is accomplished. The data form should have room for the following items: lubricant code letter, sample number, cup number, wall thickness, die temperature, and pen deflection.

Experiment Procedure: A step-by-step procedure should be written for running the experiment. Without consistent steps in running the experiment, errors can result. Because of the large number of steps needed, some steps may be forgotten if memory is relied on. The procedure covers the following major items: setup, adjustments, balancing, calibration, safety, layout of equipment and tear down. Others may be added depending on needs.

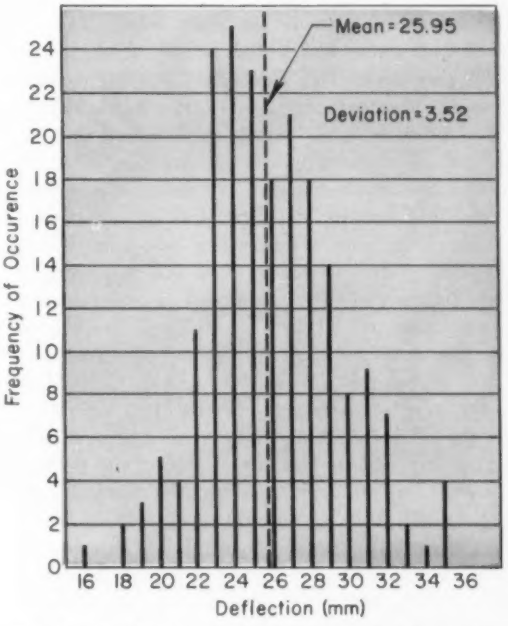


Fig. 5. Drawing force histogram for lubricant C.

The procedures represent the planning and design that have been made for the experiment. Errors here can be just as drastic as when selecting materials or criteria variables. The completeness of the procedures should be tested by a trial run.

Trial Run

A trial run is made to test equipment and procedures. The exact conditions of the experiment to follow must be used. Data collected at this time is not included in the analysis.

a sample of fifty. The experiment was run and data recorded. Any irregularities of operation were noted to assist in the analysis of data. In some cases the irregularities caused data to be invalid or not useful for analysis.

Analyze Data

The data forms were grouped and prepared for analysis. An initial study of the data and records of experiment irregularities indicated that not all data was valid. The following groups of data were ready for analysis: drawing force, wall thickness (position *A*), *Fig.* 3, wall thickness (position *B*), wall thickness (position *C*), die temperature, and cup surface finish. Due to difficulties encountered when running the experiment, only drawing force and wall thickness at position *C* were considered to be reliable.

Table 1—Drawing Force Deviation Ratings

Lubricant Code Letter	Temporary Rating	Revised Rating
B	1	1
K	2	1
C	3	2
M	4	2
D	5	2
L	6	3
J	7	3

Table 2—Wall Thickness Deviation Ratings

Lubricant Code Letter	Temporary Rating	Revised Rating
M	1	1
B	2	1
K	3	2
L	4	2
C	5	2
J	6	2
D	7	2

With the blank holder exerting the calculated force, the cups all broke. The force had to be reduced to make good cups. A force too low allowed wrinkles to form. This change of adjustment was made in the press adjustment procedure.

All of the cups produced during the trial run had the defect of "ears." This indicates that some directionality exists in the sheet metal. The ears were not severe and would be cut off during the trimming operation. This defect was not recorded during the experiment because it was common to all lubricants. An "orange peel" effect was also found on all cups indicating the severity of the operation. No burnishing or ironing was present indicating that the die clearance was sufficient.

The room temperature varied somewhat during the trial run. It was determined that any temperature averages had to be adjusted to a common room temperature of 70 F. Before each temperature reading was taken with the hand pyrometer, the die surface was wiped clean with a towel. The procedure was changed to note this operation. Cleaning was necessary to prevent lubricant from filling the ceramic cup which housed the thermocouple. The lubricant insulated the thermocouple and caused errors in temperature readings. It was determined that measurement of die temperature after each cup was not necessary. The temperature rise was too slow. For the experiment, temperature was measured every five cups or ten times for

Several reasons for not relying on the temperature data were found. Difficulty in applying lubricant to the blank caused a variation in duration times for each sample of fifty. Difficulty in cleaning the die steel prior to measuring temperature permitted cooling of the die. Tacky lubricants caused the cup to stick to the knockout plate. Delay in ejection caused error of temperature measurement. Some lubricants had to be stirred frequently to insure suspension of solid material. This changed duration time and injected an error in temperature measurements. The temperature data did not show a steady increase as predicted. No line or curve representing the data was possible. Different samples of the same lubricant gave different die temperatures.

Measurement of the cup wall thickness at position *A*, *Fig.* 3, was found to be difficult. Due to the rapid thickening of the wall near the top edge, a very slight shift in the micrometer caused considerable change in the reading taken. When plotted on histograms, positions *A* and *B* data had very large deviations.

Position *C* readings were more consistent due to less rapid change of wall thickness. Actually position C is nearer the point of maximum tension and wall thinning. Tension and wall thinning are directly related to punch force and friction; therefore, position *C* should be the best indicator of lubricant effects.

Cup surface finishes were observed. The poorer lubricants caused scoring and galling along with breakage. Better lubricants reduced marring but some scratches were still visible. It was found that when poorer lubricants were run, bits of metal adhered to the die. Thus scratches still appeared when testing a better lubricant. Due to the sequence of testing lubricants, the condition occurred repeatedly. To fully bring the die to condition after each sample, refinishing would have been necessary. Because of the detrimental effects of poor lubricants on the die surface finish, cup surface finish was discounted as a means of judging the lubricants.

The cup surface finish and defects are conclusive types of data. The results were positive and a statistical analysis was not applied. Complete failure of lubricant occurred in some cases. Friction was so high, the cups failed in tension and the cup bottoms broke away. The percent of cup breakage is in itself sufficient to use as a method of rating some lubricants.

Statistical Analysis: The remaining two sets of data were plotted on histograms. The means and deviations were calculated by the methods described previously. Typical wall thickness and drawing force histograms are shown in *Figs.* 4 and 5. These are typical histograms.

Differences did occur between the means and deviations of the seven lubricants analyzed. These differences were used to rate the lubricant's effectiveness. First, tests were made to eliminate discrimination between lubricants where a significant difference did not exist.

Temporary ratings of lubricants based on drawing force deviations were developed first. Tests for significant differences of deviations or homogeneity were made. Where the test results indicate homogeneity, a significant difference of deviations does not exist. The temporary rating was then revised to agree with the statistical tests. The lubricant having the lowest deviation was given a number one rating as this lubricant would cause less variation of force required for cupping and better control of the operation could be maintained. The ratings by drawing force deviations are shown in TABLE 1.

Temporary ratings of lubricants based on wall thickness deviations were made next. After statistical tests, the ratings shown in TABLE 2 were developed. Similar ratings were made for the means of force and wall thickness. Again statistical tests were used to verify significance of differences in each case.

The lubricant having the lowest drawing force mean was given a one rating. Lower force indicates a greater reduction of friction. The lubricant having the highest wall thickness mean was given a "one" rating. Thicker cup wall indicates less tension and therefore less friction.

As seen by the ratings, the means has a greater effect on the final conclusions than the deviations. The means gave a wider spread of ratings.

Correlation: Correlation tests were made to determine if a relationship does exist between the drawing force and wall thickness data. For a correlation test, the data is plotted on a scatter diagram as shown in *Fig.* 6. Using the plotted values a line is found which best fits the trend of the data. This is called a regression line. The slope of the line is calculated and the intercept computed. The line is then drawn on the scatter diagram. To determine fit, a correlation coefficient is found. If this coefficient is zero, no relationship exists. If the correlation is one, an exact relationship exists. The square of the coefficient is equal to the proportion of future data that will fit the line. For instance, if a five percent level of risk is selected, the correlation coefficient must be 0.975 or better for an acceptable correlation. Where correlation with desired risk does exist, the regression line may be converted to an equation relating the variables.

If a correlation exists between the drawing force

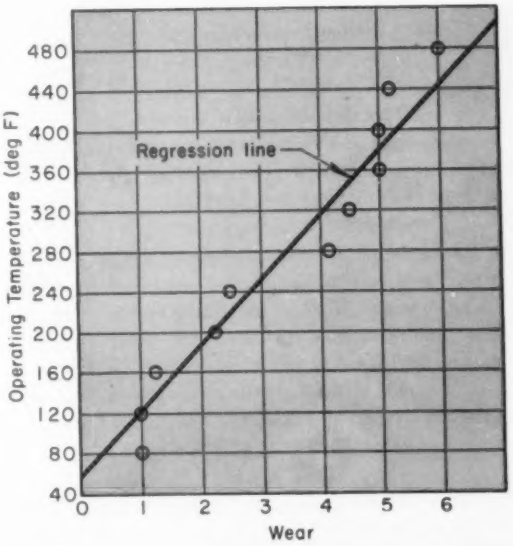


Fig. 6. Scatter diagram for correlation test.

Table 3—Final Ratings of Lubricants

Lubricant and Code	Percent Breakage	Force Mean	Force Deviation	Wall Thickness Mean	Wall Thickness Deviation	Total	Final Rating
K Chlorinated wax	00.0	3	1	1	2	7	1
J Pigmented—medium	00.0	1	3	2	2	8	2
M Graphite	00.0	2	2	3	1	8	2
C Dry wax	00.0	2	2	3	2	9	3
L Heavy oil	00.0	3	3	2	2	10	4
D Plastic	00.0	3	2	4	2	11	5
B Soap	23.0	4	1	5	1	11	6
H Lard oil	70.6	--	--	--	--	--	7
G Wet wax	75.3	--	--	--	--	--	8
E Reclaimed oil	77.8	--	--	--	--	--	9
A Mill oil	92.7	--	--	--	--	--	10
F Molybdenum disulfide	95.7	--	--	--	--	--	11

and wall thickness, these measurements can be used to determine the drawing force required. Effectiveness of die design and lubricants could be determined without force measurement equipment. Overloading of presses could be prevented.

The test was applied to find the correlation coefficient between the deviations of the force and wall thickness data. The test was also applied for the means of force and wall thickness data. Scatter diagrams were used to illustrate the correlation.

The test results were as follows:

Correlation of deviations:
- Regression line
  - Slope 0.035
  - Intercept 1.4343
- Correlation coefficient 0.1655
- Coefficient squared 0.0274

Correlation of means:
Regression line
- Slope .....−0.3279
- Intercept 38.6050
- Correlation coefficient 0.3948
- Coefficient squared 0.1559

As seen by the test results, there is far less correlation than the 95 percent desired for tooling use. The correlation coefficient squared must be at least 0.95 for desired level risk.

Ratings: The four statistical ratings and the percents of cup breakage were combined to obtain a final rating. No weighing factors were used in this combination of ratings. The final rating is shown in TABLE 3. The chlorinated wax is the best over-all lubricant for drawing low-carbon steel parts. Pigment and graphite lubricants both are rated as second best.

Correlation: Correlation does not exist between the means or deviations of the force and wall thickness data. Therefore, wall thickness measurements cannot be used to determine the drawing force or the effectiveness of the lubricant in reducing friction in the drawing operation.

As seen in this experiment, the various tools of statistics can be applied to experimental work in many different ways and for different purposes to make the job easier, quicker and less expensive. Even though statistics does not guarantee positive results, it pins down these results to a range acceptable economically. At the same time it provides an immediate check to see if variables are controlled properly and if their variations are pertinent to the problem.

"Amazing how this shop can clear out every time I want volunteers to work overtime on payday!"

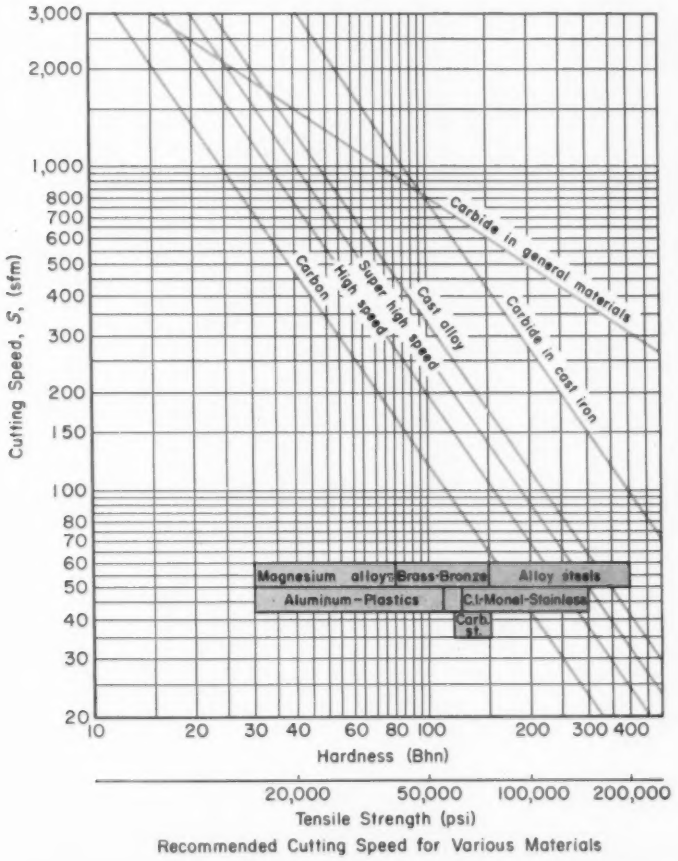
Determining Milling Horsepower

SUCCESSFUL MILLING OPERATIONS are dependent on having the right machine for the job. Adequate power is essential for best efficiency. The nomogram on the following page simplifies the determination of power requirements for milling various materials with various cutter sizes and numbers of teeth.

The first step in determining horsepower is to select the correct speed for the work material. This can be done using the chart on this page. Next, using the nomogram, spindle rpm is determined. A line drawn from the appropriate point for the selected speed (*S*) on scale 13 to the point for cutter diameter (*D*) passes through a point on scale 12 representing spindle speed in rpm (*N*). A line drawn from this point to the point on scale 7 showing the number of teeth in the cutter (*T*) intersects a point *Q* on blank scale 11. A line drawn from the spindle rpm (scale 12) through the point on scale 11 intersects scale 8. Table feed (*F*) is read at this point of intersection.

Area of cut is determined by connecting the appropriate points on scales 1 and 2 (*W* and *d*) and extending the line to scale 3. Area (*A*) is shown at this point. Then the machinability constant for the work material is found. These are shown at the bottom of the nomogram. A line drawn from point *A* through the machinability constant point (scale 5) intersects scale 6 at point *R*. A line started at the point *F* (scale 8) and passing through point *R* intersects the horsepower scale 4 at point *HP*. Horsepower is read directly from this point.

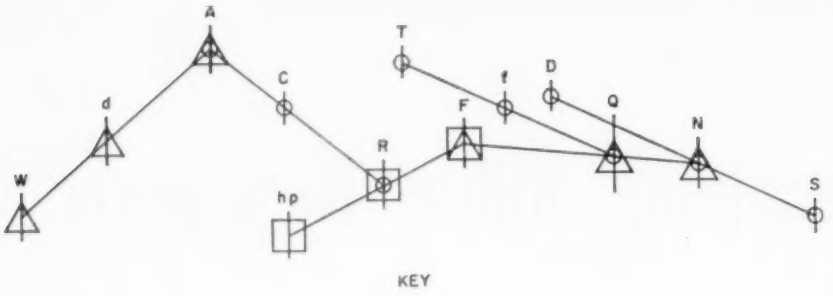
The same procedure can be used, in reverse, to determine other variables when horsepower is known.

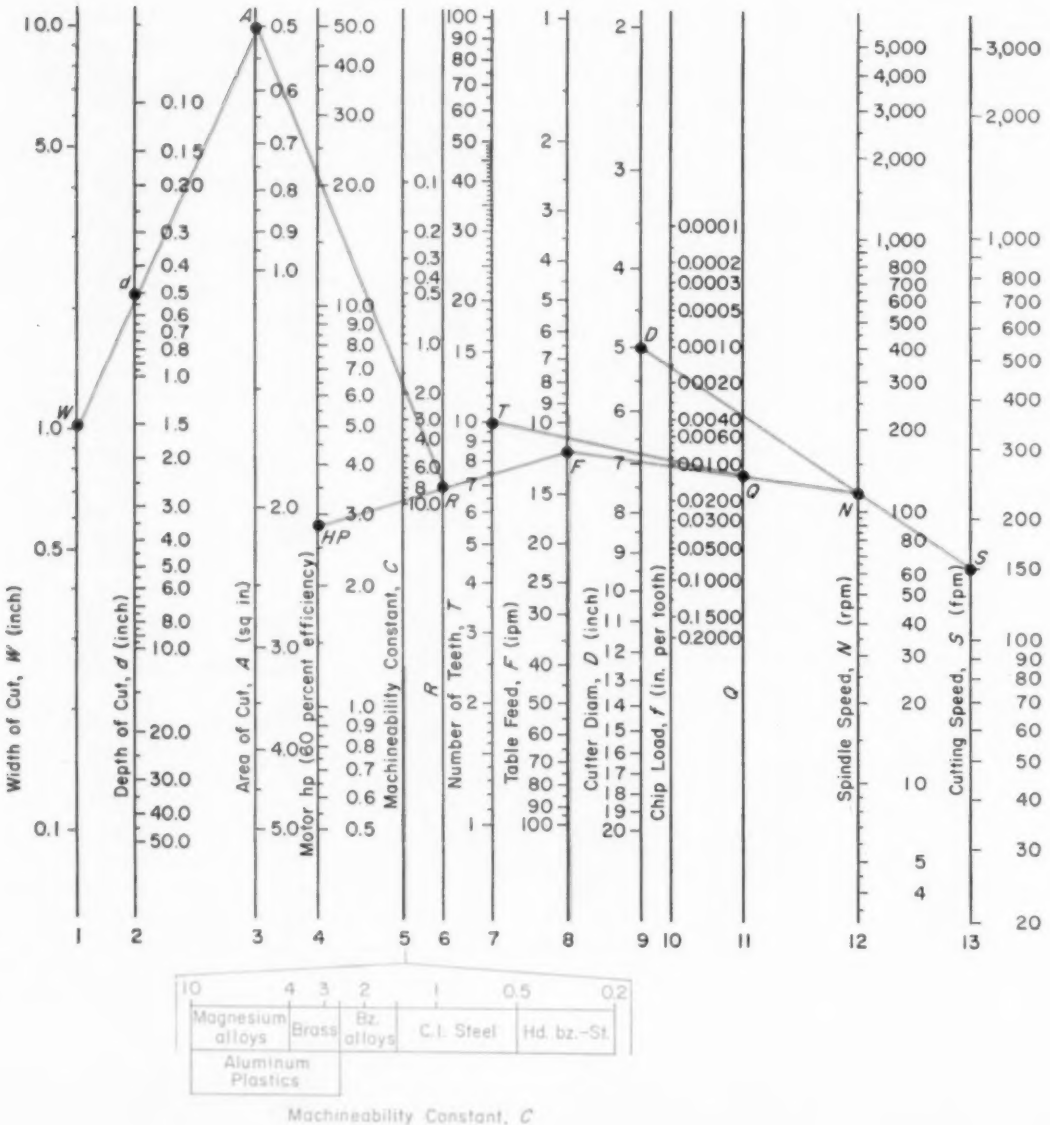


Recommended Cutting Speed for Various Materials

Data courtesy
Morse Twist Drill & Machine Co.,
New Bedford, Mass.

REFERENCE SHEET




Width of Cut, W (inch)
Depth of Cut, d (inch)
Area of Cut, A (sq in)
Motor hp (80 percent efficiency)
Machineability Constant, C
Number of Teeth, T
Table Feed, F (ipm)
Cutter Diam, D (inch)
Chip Load, f (in. per tooth)
Spindle Speed, N (rpm)
Cutting Speed, S (fpm)
1 2 3 4 5 6 7 8 9 10 11 12 13
10 4 3 2 1 0.5 0.2
Magnesium alloys
Brass
Bz. alloys
C.I. Steel
Hd. bz.-St.
Aluminum Plastics
Machineability Constant, C

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How One Chapter Helps Members to Register

The Professional Development Committee of St. Louis chapter is firmly convinced that it is good for a qualified engineer to become registered as a professional engineer. Registration benefits the engineer; it benefits his employer, his profession, his Society—and society as a whole.

Many engineers already know why they should register, but they need a little help in getting started. With this in mind, Chapter 17's First Vice Chairman William Scheublein talked on registration at the annual Ladies Night June 4. Directing his words not only to the ASTE members and wives present but also to members of the Society of Women Engineers, Scheublein explained what registration is, how it benefits the tool engineer and his family, and how the engineer must prepare for the examination.

To tell members about what to expect in the examination, when and where the exam is held, and how to take the first step, the chapter PD committee has compiled an eight-page mimeographed list of questions and answers on registration in Missouri. The list includes information on registration and renewal fees, references and grade transcripts required, length and number of exam sessions, exam rules and grading system, reciprocity, how to get forms for application, where to get copies of prior exam questions and their cost, etc.

Other pages of the booklet contain sample exam questions and answers and their fields of engineering; a listing of reference material for study and review; a listing of recommended (by ASTE) courses to prepare for registration; and a listing of the names and addresses of registered professional engineers who are members of Chapter 17. Copies of this booklet were given to those interested at the close of the June meeting, and will continue to be available to members.

The committee followed through by writing letters to the state boards of registration of both Missouri and Illinois, asking that the forms for application for registration be sent to those members who had indicated interest.

The PD program has been tied in with the chapter's expanded education efforts that include sponsorship of review courses in planning and processing and tool and die design, plus setting up of a five-year, 42-hour tool engineering curriculum at Washington University of St. Louis.

Report on ASTE Joins

When the ASTE's National Professional Development Committee journeys to Roanoke, Va., this month to raise its voice on proposed revisions of an engineering registration "Model Law," there'll be more at stake than most tool engineers realize. On the surface there may be only dry, parliamentary discussions of legal terminology. But between the lines, so to speak, there will be written a long—and yet unfinished—history of engineers' struggles to attain public recognition of professional status.

Tool engineers, as valid members of the engineering fraternity, have the privilege and the obligation of influencing the course of their profession's history. The ASTE committee will act as their spokesman at the Virginia parley.

The meeting, scheduled Aug. 20-22, will bring together representatives of the National Council of State Boards of Engineering Examiners (NCSBEE). Model Law revision is a key item on the agenda. The Society's committee, as an associate member of NCSBEE, will not have a vote but will have a voice in the decisions. It will register either the ASTE's endorsement or its disapproval of proposed changes in the Model Law. As of this writing, ASTE is expected to withold endorsement, but majority approval at the Roanoke conference of the amended Model Law is almost sure.

What is the status of engineering registration today, especially as it affects tool engineering? Why do registration laws exist in the first place? What is good about them? What is wrong with them? Why a Model Law? What provisions in the proposed Model Law preclude the ASTE's wholehearted endorsement of it?

The answers to these questions tend to be as complex as the civilization that has made such laws necessary. The answers concern the tool engineer because he has been such a vital contributing force to civilization as we know it—and because his contributions have often gone unrecognized.

Professional engineering registration in this country is a legal device that enables engineers to demonstrate their worthiness to practice their pro-

Professional Registration: Talks on Model Law

by M. L. Stone
news editor

fession. Laws governing registration are promulgated by the individual states. The often-overlooked *purpose* of licensing laws, whether they apply to lawyers, doctors, architects or engineers, is to protect the public health and welfare. Although the laws are nominally legislated to safeguard the public from incompetent practitioners of a profession, in reality they serve as prestige symbols for qualified members of the profession.

Engineers employed by others, which is true of most tool engineers in industry today, are generally not required to be registered. But increasingly tool engineers are realizing that, by becoming registered, they are raising the standards of engineering practice and particularly are enhancing the stature of their own profession and of the American Society of Tool Engineers. Aside from these advantages, tool engineers who have registered are giving testimonials to the personal satisfaction and benefits, often quite tangible, that they have derived.

As one of the newer divisions of the profession, tool engineering has yet to realize full standing in the eyes of the public and of other engineers. The tool engineer is just as clearly distinguished from a mere craftsman as any of his engineering brethren, because he must apply scientific knowledge and methods to production. He has been responsible for a large part of today's industrial progress. Despite his attainments, he must yet fight for his birthright as a "professional," and one of his best weapons is professional registration.

Complicating the professional registration picture as it applies to engineering is the fact that licensing laws vary widely from state to state and are almost universally in need of modernization and standardization. The tool engineer, as well as his fellows in the many other branches of engineering, must constantly be on guard against legislation that is motivated by selfish desires for exclusiveness rather than by a professional pride in the equitable recognition of merit.

Further complicating professional engineering registration is the fact that more often than not the public health and welfare is in no way involved. It is certainly obvious that there are many more engineers whose work does not endanger the citizenry than there are engineers whose activities do directly affect the public welfare. It would seem logical, therefore, to categorize engineers and set up different requirements for those in, say, architectural and structural engineering, than for those in other branches. But legislation has historically failed to define the wide differences that exist among the types of engineering and has lumped them all under a single set of regulations. The laws cover engineering work in general but usually list only a few branches specifically. Many engineers fall within the general provisions but not within one of the specific branches named. They are thus faced with the necessity of being examined in some field other

Charles H. Thuman of Evansville, Ind., is chairman of ASTE's Professional Development Committee.

Professional development program at St. Louis is typical of the help a chapter can be to an engineer who wants to become registered. Not typical, however, is the fact that the chapter's Professional Development Committee chairman is a woman, and a registered engineer in the state of Missouri besides. Here, tool engineer Paulena Pagel plans program on registration with the help of (left to right) William A. Scheublein, chapter first vice chairman; James A. McNeely and Robert W. Hanpeter, of the Professional Development Committee; and Chapter Chairman Kenneth W. Ritter.

than their own specialty to become registered.

Legal control of engineering has not existed as long as that of the older professions such as medicine and law. The first engineering registration legislation was enacted in Wyoming in 1907; by the Twenties, about half of the states had followed suit; and now every state has such laws.

Aside from the possible perversion of basic purpose—to protect the public health and welfare—the greatest shortcoming in licensing laws to date has been their exclusion of the newer, though equally legitimate, divisions of the engineering profession. To rectify this common failing and other shortcomings of ambiguous language and "toothless" provisions for enforcement, several so-called model laws have been drawn up for the guidance of state legislatures. The forthcoming Virginia conference of NCSBEE is a further effort to find the modern solution to these old problems.

Tool engineers, through the medium of the ASTE's National Professional Development Committee, will continue at Roanoke their crusade for fair and well-defined registration laws. They have always joined forces with their engineering colleagues who oppose restrictive or discriminatory legislation. Laws that "play favorites," they realize, are class legislation and tend to hinder rather than help engineers as a whole in their struggle to attain public recognition of professional status.

Conscientious proponents of registration law revisions are aware that there are many capable engineers who have learned their profession through years of hard work, yet cannot pass a highly theoretical written examination that may be given them by some state Boards of Examiners.

Tool engineers have traditionally been opposed to legislation that tends to hamstring corporate activities, such as the following law that exists in one of the most highly industrialized states: "... All partners and directors of (architectural or engineering or land-surveying firms) shall be registered architects, registered professional engineers, or registered land surveyors."

Reasons for Committee's Objections

It is against this background that the National Professional Development Committee will join in the deliberations on proposed revisions to the current Model Law. The NPDC, which is chairmanned by Charles H. Thuman of Evansville, Ind., is expected to withhold ASTE endorsement of the revisions because of fear that they may:

- Tend to make registration more difficult by requiring more years of experience
- Be interpreted to require more people engaged in "engineering" to become registered.

In connection with the latter objection, the committee is concerned that sections of the law which define and control corporate practice may be too

arbitrary. In an interim report to the NCSBEE after study of the first draft of Model Law revisions at its meeting in March, the NPDC urged elimination of the following proviso:

> The practice of professional engineering may be performed by employees of a firm, copartnership, joint stock association or corporation engaged in production, manufacturing, transportation, distribution or communications, insofar as such engineering services are involved in its operations, PROVIDED: such engineering service is performed by professional engineers. All plans, designs, drawings, specifications or reports involving engineering judgment and discretion shall be dated and bear the seals and signatures of the professional engineers who execute such work.

The Society's committee urged that "care be exercised that such provisions do not limit or encroach upon industrial organizations not engaged in engineering practice." To this end, the tool engineers would insert a saving clause to this effect:

> This Act shall not be construed to prevent or to affect . . . . the practice of any other legally recognized profession or trade or the practice of engineering performed by employees of a firm, copartnership, joint stock association or corporation engaged in production, manufacturing, transportation, distribution or communications insofar as such engineering services are involved in its operation, or the design of manufactured products for the quality of which the manufacturer thereof assumed responsibility.

In addition to these reservations, the Society's general counsel found the proposed Model Law objectionable because of a vagueness in defining fundamental terms such as "professional engineer."

The revised Model Law would define a professional engineer as "a person who, by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and engineering experience, is qualified to practice engineering, as attested by his legal registration as a professional engineer."

Definitions have been the perennial thorn in efforts to write fair and water-tight engineering laws. The "professional engineer" in one state may be quite a different breed in another. Although the definition of an engineer may be similar in a majority of states, the requirements for a man to be registered as one vary sharply.

The trend is toward professional registration. This is the age, in fact, of licenses. Pity the professional man who possesses not a sheepskin, a certificate, a seal, an attestation of attainment, or a license of some sort, for he cannot truly call himself a "professional" in some circles.

One estimate is that of 600,000 engineers in this country, half are registered. The percentage of ASTE members who are registered—about one in twenty—is far below the national average, but the gap is closing. For many tool engineers are realizing that their profession will continue to grow in stature in spite of them, if not with them.

Although the ASTE recognizes that clothes don't make the man or certificates the engineer, it does recognize the importance of fostering the professional growth of its members. Attainment of professional registration status is a means to this end. That it is only a means, not an end, is perhaps attested by the fact that the Society last year changed the name of its operating arm in this field from the National Professional Engineering Committee to the National Professional Development Committee. The new name more aptly expresses the scope of this important Society activity.

This new slogan to express the spirit and breadth of the tool engineering profession will soon be appearing on all communications from ASTE Headquarters. The national officers approved the slogan at their June meeting in Chicago.

Members in the News

WILLIAM OWEN, registered professional engineer in Pennsylvania, and past chairman of Pittsburgh Chapter 8, has retired from his position as chief design engineer of plate glass with the Pittsburgh Plate Glass Co. Owen's career with PPG spans two world wars and several decades of the company's growth. He holds 137 patents for various glass manufacturing and cutting equipment, is a writer and has contributed articles to several tool and production magazines.

An acknowledged leader in automation, pioneer researcher into servomechanisms and mechanical methods of computation, JACOB J. JAEGER stepped from his position as executive vice president into the office of president of Pratt & Whitney Co., Inc. Jaeger, who is a member of Hartford chapter, joined P & W in 1940. He is an internationally known authority on numerically controlled systems, in which field P & W is now prominent. At the Milwaukee Convention in April he received the ASTE Engineering Citation for his pioneering in and promotion of numerical control.

R. K. LeBlond Machine Tool Co. has announced the appointment of ROBERT E. MCKEE as sales manager. McKee, for three years chairman of the National Education Committee and formerly education chairman of the Ann Arbor Area chapter, is now a member at Cincinnati. He has served on various other committees on both the national and chapter levels. From 1942-1956 McKee acted as assistant professor of metal processing, associate professor of production and mechanical engineering at the University of Michigan and has done extensive research work for various companies and governmental agencies in the field of machinability and metal cutting. He has been in great demand as a speaker, giving talks to technical societies on cutting fluids, abrasive operations and metal-cutting.

ARTHUR J. HILL, Detroit chapter member, will leave July 1 for Utterpara, Calcutta, India, where he will take up a new position as superintendent of new machinery and tooling, Hindustan Motors, Ltd. He was formerly with Michigan Tool Co., where he served as a service engineer. Hill, who is anxious to familiarize the Indian automotive manufacturer with the ways of American tool engineering, would appreciate any trade literature that makers of machines and machine tools might be interested in sending him at his new Indian address.

GEORGE D. SCHATZ, Paterson chapter, has been appointed assistant manager of sales for the Sandvik Coromant line of Sandvik Steel, Inc. Schatz has been with Coromant sales department for the past three years . . . HOWARD FISH, Milwaukee, who has been promoted to manufacturing manager, is one of four men appointed to the manufacturing staff at AC Spark Plug Div. of General Motors. Fish joined AC in Flint in 1933, served as general foreman in 1948 and the following year was promoted to superintendent, when he established the machining division. In May, 1956, he was made head of the gyro manufacturing department where intricate systems are made for guided missiles, and became assistant materials mechanic in 1957 . . . HAROLD C. BURGESS, Cleveland, district sales manager for Latrobe Steel Co. for the past 21 years, has been named Ohio regional sales manager. . . . ERNEST C. HAWKINS, Pittsburgh, has been appointed to the sales staff of McBeth Machinery Co. . . . Frick Steel Co. has announced the appointment of RAY C. SMITH, a Dayton member, as vice president in charge of sales after 17 years' association with the company as Dayton sales manager. . . . AL DAMES, Los Angeles, with a diversified background of technical and sales experience, has been appointed sales manager of Hastings Plastics. Dames, who began his plastics career in the pioneering days, has been responsible for the design and construction of practically every known variety of plastics tools.

LEO YANOFF, a member of Binghamton chapter, has been appointed staff engineer of Systems Component Coordination at the Owego facility of International Business Machines Corp. This facility is engaged in the research, development, and production of bombing, navigation, and missile guidance systems and other products in government contracts. Yanoff began his association with IBM in January, 1955.

KARL SCHWARTZWALDER, Saginaw Valley, director of research at AC Spark Plug Div., GMC, has been awarded the John Jeppson medal, which was established by George N. Jeppson in memory of his father, a ceramic industry leader and one of the founders of the Norton Co. The award was in recognition of Schwartzwalder's "scientific, technical and engineering achievements in ceramics." Schwartzwalder, who was AC's chief ceramic engineer before being made research director in 1955, holds 25 patents in the field of metals and ceramics.

John W. Groomes (right), newly appointed administrative assistant, confers with Executive Secretary Harry E. Conrad. Groomes will handle liaison work among various ASTE committees.

New Personnel at Headquarters

REFLECTING THE MATURITY and presaging the further growth of ASTE is the appointment of three new men to Headquarters staff. One of them fills the newly created position of administrative assistant to the national executive secretary. Another is a new public relations director, hired to guide a revamped approach to the Society's efforts in this field. The third man will work under the public relations director as communications manager.

John W. Groomes will act as Executive Secretary Harry E. Conrad's administrative assistant.

"Groomes will handle liaison work among the Society's committees and departments, at both the national and chapter levels," said Conrad. "He will attempt to prevent overlapping of programs and will coordinate the Society's various activities."

Groomes comes to ASTE from East Lansing, Mich., where he was executive director of the national Junior Engineering Technical Society (JETS) and director of the JETS program at Michigan State University, where the organization was launched in 1950. Before joining the MSU staff, Groomes taught advanced mathematics and physics at Traverse City, Mich., for two years. Prior to that he worked for several years in various engineering and supervisory capacities in the automotive and aircraft industries, including the Allison and Fisher Body Aircraft divisions of GM, Kaiser-Frazer Aircraft, and Cadillac. A World War II veteran, Groomes took pre-engineering work at John Carroll, Case Institute, and Columbia University under the Navy's V-12 program until he was commissioned. In addition, he holds a degree from Alma College and has done postgraduate work at Michigan, MSU and Central Michigan.

Contributing literal stature to the Society is the new public relations director, E. Leo Koester, a 6-foot, 7½-inch addition to the staff from Cincinnati. Under Koester, the public relations program of ASTE will be channeled more toward telling the Society's story to the millions who reap the benefits of tool engineering but who don't know what a tool engineer is. Koester will direct a concentrated effort to enlist the good will of industry.

The new director comes to ASTE by way of the National Association of Manufacturers and the Crosley Division of AVCO, where he was public relations director for the electronics manufacturer. Koester also spent nine years as a reporter for a Cincinnati daily. He, his wife, three sons and a daughter have moved to Farmington, a Detroit suburb.

Joining ASTE Headquarters as communications manager, a new post, is Don McAnally, who has held advertising, public relations and sales positions with Libbey-Owens-Ford Glass Co., Toledo, Ohio, and the firms subsidiary, LOF Glass Fibers, for 11 years. McAnally spent nearly four years as publication editor for the Owens-Illinois Glass Co. in Toledo and Glassboro, N. J.; and ten years in varied editorial, advertising and circulation jobs on New Jersey newspapers. With the ASTE he will handle promotion and publicity for the Society's tool shows, magazine, and other publications. McAnally has a wife and daughter.

Discussing their new assignments at "10700" are Don McAnally, communications manager, and E. Leo Koester, public relations director.

Extending their welcome to tool engineers this October will be two of St. Louis' great expanses. Reaching westward into the city of 900,000, on the left is the historic Eads Bridge, completed in 1874 as the first St. Louis span to cross the Mississippi. At right is the Veterans Memorial bridge.

Gateway to the West

THE "GATEWAY TO THE WEST," St. Louis, will open to members of the American Society of Tool Engineers this October and waiting there to greet them will be a 14-man delegation, the nucleus of St. Louis Host Committee. For those attending the Semiannual Meeting to be held Oct. 7-10, a reception and itinerary befitting a king have been planned. In fact, there will be a king and, although he will not be directly connected with the ASTE meeting, his presence is not going to be overlooked by the convention planners.

Charlton A. Brown, chairman of the host committee, has seen to it that those who attend the four-day affair in St. Louis will be able to view the king, His Mysterious Majesty, the Veiled Prophet of Khorassan, from the Starlight Roof of the Chase Hotel as he parades below with his royal entourage on the first evening of the Semiannual Meeting. The Prophet leaves his mythical domain only once a year to put in an appearance in the city and open the local social season by crowning a queen from among the year's debs. The reception on the Chase rooftop will precede the St. Louis Day Dinner, a kickoff gathering at which ASTE President Wayne Ewing will welcome the crowd and Dr. Ross M. Trump, dean of business administration at Washington University, will appear as main speaker. In order that key St. Louis industrialists, educators and civic leaders may attend this dinner, a budget has been set up to subsidize the cost.

But the Veiled Prophet will fade into the background once the conventioners get down to the business at hand: that is, technical sessions, 12 in all; three plant tours; and a two-day meeting of the Board of Directors taking place on Thursday and Friday.

"Tooling for the 60's" has been selected as the theme for the St. Louis meeting. This theme will carry over into the 24 papers as they are presented during the course of the meeting. The titles applied to the technical sessions clearly denote the emphasis that is being placed on what the tool engineer will face in the future and how he can face it more easily with more advanced ideas and technology. Such phases of tool engineering as electronics applied to inspection problems, importance of positional tolerancing and plastics as a tool material, will be covered in the program. The basic problems that often confront the tool engineer in his work will also be included; for instance, handbooks and how to use them, shop techniques, safety and the tool engineer, and how the tool engineer adds to profits. Vincent

L. Bené, chairman of the technical sessions at the Semiannual Meeting, promises nothing but stimulating, informative discussion on the part of the experts enlisted as technical speakers.

Picked as the sites to be visited by the ASTE members on their tours of the local plants are the Owens Illinois Co., Emerson-Electric Mfg. Co., and Carter Carburetor, Div. of ACF Industries, Inc. Plant tours Chairman Louis Malpocker feels that these plants will hold the most interest for the visiting tool engineers. On their trip to the first company, visitors will see one of the most modern machine shops in the United States. The shop makes repair parts as well as machines for all the company's factories. At Emerson the complete manufacturing operation of fractional horsepower motors will be on display. Production, inspection and toolroom operations, including die casting of zinc alloy and aluminum, will be among the processes seen at Carter.

The ladies will not be lost in the St. Louis shuffle. Once they register with their husbands, they will be entitled to take part in a whirlwind series of events especially planned for them by the chairman of the Ladies' Activities, Erwin P. Huchzermeier, who is

The last event of the Semiannual Meeting, a combination supper and dance, will leave the three to five hundred ASTE members and wives with nothing but fond memories of St. Louis and the 1959 Semiannual Meeting held there. At least this is what the Host Committee hopes for and, from the way things are progressing down St. Louis way, this is exactly what will happen.

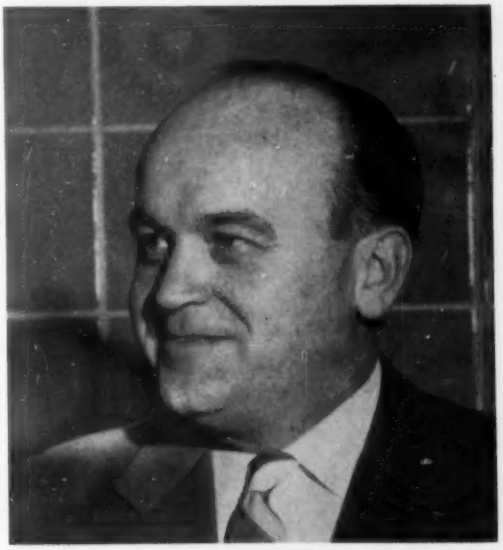
After this inviting report on what awaits the ASTE member in the Missouri city this October, it is only fair that the men responsible be given recognition for their efforts. Chosen to represent St. Louis in its duties as host committee are: Charlton A. Brown, general chairman; Glen Dilling, vice chairman; Clarence Hall, secretary; Louis Malpocker, plant tours; Erwin P. Huchzermeier, ladies' activities; Vincent L. Bené, technical sessions; Willis J. Potthoff, supper-dance; Richard D. Bardes, St. Louis Day Dinner; Richard Britt, publicity; Gene Frerichs, transportation: Dolph Boettler, emergency; Clarence L. Miller, reception; and Harry O. Munn, tickets. Paul W. Vierling, member of the National Program Committee, is the NPC Zonal Member of the group.

. . . Opening to ASTE

being assisted by his wife. Naturally, there will be a convenient hospitality room, the Colonial Lounge, where they can meet, talk over coffee, and even watch TV or play cards if they wish. A "Get-Acquainted Breakfast" has been planned for just that reason, a chance to make new friends and learn what's on the agenda for the balance of the convention.

The highlights of the ladies' doings will be a visit to the "Charlotte Peters Show," a local TV program devoted to fun, fun that results mostly from the antics of those selected from the audience to aid the star of the show. In this case the audience will be the ASTE wives. Ernie Feldman and his wife, masters at magic, will provide more entertainment for the female contingent on Thursday evening of the meeting. While their husbands are attending a technical session, wives will marvel at the feats of this St. Louis sorcerer in the Colonial Lounge.

But the fun will not be reserved solely for the ladies. Monte Carlo Night will provide both the men and the women with an opportunity to test their gambling luck. Games of chance can be played and perhaps even won with the help of play money. Win often enough and the money can be redeemed for valuable prizes.



Heading the St. Louis Host Committee is Charlton A. Brown. Brown has served his chapter as chairman, first and second vice chairman, chairman of the Education Committee and member of the Professional Engineering Committee. At present, besides his duties as host chairman, he is chairman of the Advisory Council of Chapter 17.

An Open and Shut Case of Good Public Relations

TWELVE WOODEN SUITCASES of mysterious proportions have been making the rounds of the various ASTE chapters for the last several months and have been causing quite a sensation. Usually upon their arrival the gray wooden cases are entrusted to the care of the chapter public relations chairmen. The gentle care and handling afforded them only add to the air of secrecy surrounding them.

But once the contents of the portfolios are revealed, the mystery fades and it becomes clear what they are intended for. They are Public Relations Display Kits and they are meant to attract, interest and inform.

Introduced by the National Public Relations Committee to assist chapters in telling the ASTE story, the kits contain samples of every type of literature distributed by the Society. Ranging from THE TOOL ENGINEER magazine to ASTE handbooks, from technical papers to historical pamphlets, the literature is arranged on a display board which can be set up at chapter meetings, local exhibitions, special industrial events, fairs, school programs, technical meetings of other professional groups, and similar events. Also included in the kit is a display poster describing the benefits of membership in ASTE. This, of course, is directed toward those unacquainted with the Society and its functions. It maintains a dominant position in the center of the display board.

A Public Relations Display Kit, set up properly, can arouse the interest of prospective members unfamiliar with the functions and activities of the Society. It has also been known to rejuvenate old members who have come to take the ASTE for granted.

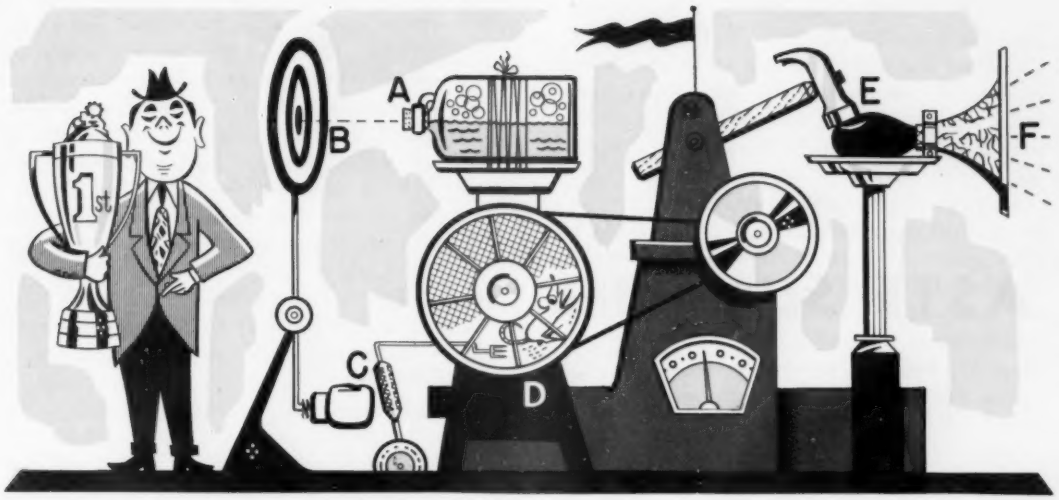
Members of the National Public Relations Committee who have carried the kit with them to the chapters have conveyed nothing but glowing reports on its results. Those chapters which have already displayed the portable kit have requested that they be allowed to use it again as soon as possible, so effective was its presence at their meetings. Student chapters having set it up on campus report a marked increase in those interested in joining the Society at the college level.

Not only does the PR kit prove valuable in indoctrinating nonmembers in the purposes of the Society, but in introducing new members to the many aspects of ASTE unfamiliar to them.

It is unfortunate that there are only 12 kits available at the present time, for the demand has been overwhelming. But this has only been a trial run. If the demand continues more kits will be constructed. In the meantime, however, chapters wishing to procure the kits for use at meetings or any other events where they would gain attention, should contact the Public Relations department at ASTE headquarters well in advance of the proposed meeting dates. This is necessary because on several occasions two or more chapters in the same area have requested kits for the same evening. It was the chapter entering the earliest bid that got the kit.

Usually upon its return from chapter use, the kit is accompanied by a letter of praise. Such comments as, "very effective in our situation," "evoked a great deal of interest" and "when can we have it again" are not uncommon.

So when the wooden box arrives at your chapter, set it up in a strategic spot on a table or easel, spread out the contents and make sure new members, old members and just plain interested parties see, read and take home the literature provided. For, unlike that curious mythological lady, Pandora, and her box of evil, this PR box holds nothing but good things for the person anxious to know what's inside it and the ASTE.



New Gadgets Contest!

HERE'S YOUR OPPORTUNITY to divulge that revolutionary idea that's been haunting the caverns of your tool engineering subconscious for so long. Chances are during the course of your work you have been faced with a problem you're sure others like yourself have faced, one which with a little ingenuity could easily be solved. If your solution is relatively simple (unlike the above illustration), fairly inexpensive and of practical value to tool engineers, put it down on paper and prepare to enter it in THE TOOL ENGINEER's Gadget Contest beginning Oct. 1.

The theory behind any device or method that might make the work on production jobs or in the toolroom simpler and safer, presented in a clear, intelligent description of 500 words or less and accompanied by an illustration will be paid the fullest attention by the panel of judges. So, if you have an idea for a unique gadget (and what tool engineer doesn't!), read the rules below carefully and take a look at some of the gadgets appearing in that section in the front of the magazine. If your idea is selected as one of the best, you'll not only receive an award, but your entry will be published in THE TOOL ENGINEER for other ASTE members to see, study and perhaps put into effect.

Contest Rules

1. Eligibility: The contest is open to all members of ASTE.

2. Definition: "Gadgets" are defined as tools or methods developed to solve specific production problems. They should contain a useful and practical idea or indicate an ingenious solution to a tool engineering problem.

3. Prizes: One $100 first prize, two $50 second prizes, four $25 third prizes, and honorable mention awards which will be a choice of the **Tool Engineers Handbook**, 2nd Edition, or **Die Design Handbook** published by ASTE. Certificates will go to all prize winners.

4. Period: The contest will run from Oct. 1 until Dec. 31, 1959. Contributions to the Gadgets Dept. received during this period from ASTE members will be considered entries.

5. Judging: Entries will be judged on the basis of originality and usefulness to other tool engineers, clarity of illustrations, conciseness and completeness of presentation. Members of the National Editorial Committee will serve as judges. Winners will be notified by mail as soon as possible after completion of judging. A list of winners will be published in THE TOOL ENGINEER.

6. Entries: Name and chapter affiliations of the author should be written on each page of the entry. No entries will be returned. Information which has been published previously in a periodical or national magazine will not be considered. All publication rights are assigned to THE TOOL ENGINEER. Authors of entries published in THE TOOL ENGINEER will receive honorariums.

7. Length: Entries should be limited to 500 words or less. Sketches or photographs should be used to illustrate the methods or devices described in the text of the entry.

8. Mail entries to: Gadgets Contest Editor, THE TOOL ENGINEER, 10700 Puritan Ave., Detroit 38, Mich.

ASTE Schedules 13 Seminars

ACCEPTING the suggestions and critical acclaim of observers, the National Program Committee decided to "take the show on the road." The "show" referred to was the creative manufacturing seminar on ceramic tooling held at the Annual Meeting in 1957. Developed originally as a part of the yearly meeting, the seminar aroused so much interest it went on tour of the cities of St. Louis, Chicago and Cleveland that same year. This was the beginning of the now-extensive yearly series of creative manufacturing seminars sponsored by ASTE. Not only have the seminars grown in number—this year there have been nine so far, and 13 more are scheduled for the coming fall and spring—they have grown in scope and impact. Except for the one seminar conducted at the Annual Meeting, which is still held under the aegis of the NPC, the seminars are now planned and conducted by the National Education Committee.

Held because of their unmistakable educational value to all who attend, the seminars have fulfilled five primary objectives. They are: to present the latest technical information on tool engineering; to inform manufacturing management of the importance of ASTE to engineering personnel; to provide a national educational service for production, tool and manufacturing engineers; to provide a means for chapters to cooperate in a national education program; and to bring about an increased awareness of the importance of ASTE to the manufacturing industries throughout the world.

The extensive planning that precedes the actual seminar may not be evident to the attender. But it's the behind-the-scenes action that makes a program successful, and sends the registrant home with a notebook full of knowledge on a subject which hitherto might have been a complete mystery to him.

"Operation Seminar" begins something like this: The National Education Committee receives the host chapter's approval of the subject and of the date it will be offered. Recruiting and scheduling of program personnel is carried out by the national education director, Gilbert E. Seeley. It is then the privilege of the chapter to appoint the seminar chairman and moderators. National Headquarters supervises all promotion, publicity and printing that must be done. The education director arranges for the hotel seminar site, once more with the chapter's approval. Finally, Headquarters can be counted upon to handle all money and pay all bills.

This brief summary of the history and background of the creative manufacturing seminars is intended to give the prospective attender some insight into what lies behind these engineering workshops, that is, how they came about and what purpose they serve. No written explanation can take the place of actual observation though. And this may be obtained at any one of the following seminars scheduled tentatively to run from Nov. 10 through May 5:

WHAT WE KNOW TODAY ABOUT METAL CUTTING

Jan. 21-22, 1960	Sheraton-Palace Hotel, San Francisco
May 4-5, 1960	LaSalle Hotel, Chicago

METAL FORMING METHODS FOR TOMORROW'S MANUFACTURING

Nov. 10-11, 1959	LaSalle Hotel, Chicago
Mar. 3-4, 1960	Ambassador Hotel, Los Angeles
Mar. 23-24, 1960	Bond Hotel, Hartford

COST REDUCTIONS THROUGH PLASTIC TOOLING

Feb. 24-25-26, 1960	Chase-Park Plaza Hotels, St. Louis

AUTOMATION AND YOUR PRODUCTION PROGRAM

Feb. 2, 1960	Sheraton-Cadillac Hotel, Detroit

NUMERICAL CONTROL IN CREATIVE MANUFACTURING

Dec. 10, 1959	Bond Hotel, Hartford
Jan. 19, 1960	Ambassador Hotel, Los Angeles

SOME PROBLEMS OF MACHINING SPACE AGE METALS

Nov. 18-19, 1959	Ben Franklin Hotel, Philadelphia
Mar. 8-9, 1960	Sheraton-Palace Hotel, San Francisco

OPTICAL TOOLING METHODS IN MANUFACTURING

Jan. 12, 1960	Ben Franklin Hotel, Philadelphia
Mar. 1-2, 1960	Ambassador Hotel, Los Angeles

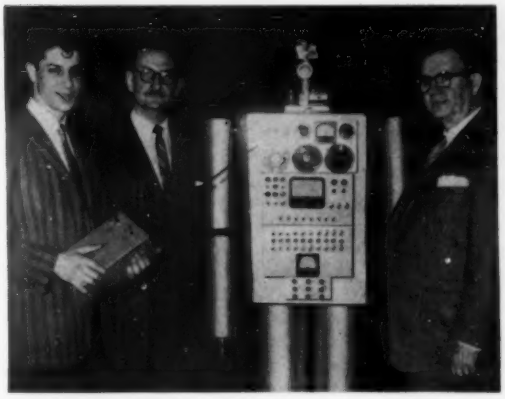
Chips and Chatter

When a Cad crashes the tool business, it shakes the very foundation, as witness this picture of the Peerless Engineering Co. in Los Angeles. Owned by Vaughn Clark and Arthur Smith, two ardent supporters of LOS ANGELES CHAPTER, Peerless is a precision tool shop that employs about 25 men on the day shift and one cat on the graveyard shift. The cat was luckily out for a midnight snack when the Cadillac entered the shop, missed a $35,000 Pratt & Whitney jig borer by three inches and upset a benchful of precision tools. The driver was upset too, but unhurt. Next day, needless to say, Clark and Smith's business was picking up.

Charter editorial chairman of ITHACA CHAPTER is Anna B. Gage, widowed mother of two, grandmother of six. She joined Morse Chain Co., makers of power transmission products, as a lathe operator in the sprocket department in 1942; soon she branched out to other machines, earned her machinist A rating, and in 1949 was promoted to her present position as process engineer. She joined the ASTE movement in Ithaca because she realized it would be a "good source of ideas—I always try to look ahead for something new to learn."

QUOTE OF THE MONTH: "When a company invests some of its capital in plant and machinery to make a new product, it establishes a reservoir of future profits, taxes and job opportunities. When a plant is built outside of the country, the United States loses this reservoir."—Ralph E. Cross, executive vice president of The Cross Co. and member of DETROIT CHAPTER, speaking at the Institute of Labor and Industrial Relations, St. Clair, Mich. To combat the current trend of building American plants overseas to make them competitive with foreign industries, the automation executive suggested revision of tax policies on plant and equipment depreciation, increased productivity, expansion of research and revival of incentives.

CHAPTER NO. 7 manned a booth at this year's National Science Fair which was held in the chapter's home city of Hartford, Conn. The ASTE booth consisted of a 20-foot-long backdrop made up of panels five feet wide and eight feet high checkerboarded with copies of covers from THE TOOL ENGINEER under plasterized glass. In front of these were two big benches, one holding a New Departure ball bouncer, the other a P&W memory device used on jig borers and grinders. The chapter also awarded five Savings Bonds for the best exhibits.



Built mostly of parts from pinball machines, this robot recently performed for members of TRENTON-DELAWARE VALLEY CHAPTER. The brain and brawn child of Charles J. Lombardo (left), honor student at Trenton Central High, it can add, subtract, multiply, divide, take square root; find the sine, cosine and tangent of an angle by means of an analog computer; move in all directions; tell sweet from sour and hot from cold; contains a digital computer which adds any two numbers whose sum does not exceed 1023; is light directional; and can be operated remotely by a radio control. With Charles are Chapter Chairman Morris W. G. Bahr; the robot himself; and C. M. Diamond, teacher.

chapter news and views

ST. PETERSBURG—Officers of the newly chartered Chapter 159 appear after their installation. They are (left to right) Robert Best, second vice chairman; Bernard Bryant, treasurer; W. A. Simcox, chairman; Charles J. Grimm, secretary; and Keith White, first vice chairman. *—James H. Veith*

Five ASTE Chapters Convene at Ferris

GRAND RAPIDS—Ferris Institute in Big Rapids, Mich., was the scene of a joint meeting of the Grand Rapids, Muskegon, Kalamazoo, Benton Harbor-St. Joseph, and Battle Creek chapters of ASTE on May 15. Arrangements for this campus program were made by Grand Rapids chapter member Howard Vanderbilt, who is also an instructor of mechanical drafting at Ferris.

"Today's Missiles and Their Effect on Tooling" the main talk of the evening, was delivered by Joseph Straayer of Chrysler Corp.'s Missile Div. He accompanied his discussion with a film depicting the development of rocket-propelled missiles and space vehicles.

A presentation of membership achievement awards preceded Straayer's speech, with acknowledgment going to the Benton Harbor-St. Joseph chapter. Following the talk was a tour of the school's Trade and Industrial Center conducted by Dean Adams, a member of the Grand Rapids chapter.

—T. E. Diebel

Cutter Grinding Concepts Discussed at Rochester

ROCHESTER—Chapter 193's technical speaker at its April meeting was William Johnson, sales manager of the Royal Oak Tool Co., Royal Oak, Mich. With the topic, "Modernize Your Cutter Grinding Concept," Johnson offered the members some advice on how to improve cutter grinding in their own shops. *—O. E. Hosford*

PASADENA COLLEGE—President Wayne Ewing presents Pasadena City College student chapter charter to Chairman Clifford Davis. The new student group was sponsored by the San Gabriel Valley senior chapter.—*Bernard K. Allen*

OGDEN—Presenting the gavel and chairman's pin to S. H. Parsons, Jr., is Leslie Seager, national director. Also present at the April chartering of Chapter 156 were George Dewey Clyde, governor of Utah, and ASTE President Wayne Ewing.

Explosive Forming Technique Described In Kalamazoo Talk

KALAMAZOO—Explosive forming, said J. W. Schiffel, guest speaker at the May meeting, is the process of deforming sheet steel to a desired requirement by the use of propellants, under controlled conditions. Schiffel, chief engineer of the special projects department of the Ingersoll Kalamazoo Div., Borg-Warner Corp., is presently in charge of research and development work in connection with material, methods and fabrication processes for inert metal parts for missile boosters, jets and rockets.

There is little knowledge of the phenomenon of explosive forming, he said. It has been within the last two or three years that there has been any concerted activity in this field. At present there are only 45 companies in the United States that are participating in such a program.

The tooling required for explosive forming is very simple, Schiffel explained. Under the metal product sheet is a die made of mild or hardened steel; plaster of paris has even been used. The die is then placed in a strong, open-topped container. When the container is filled to the proper height with water, oil or other liquids, a cover is placed over it from which is suspended the prime activator—anything from a high-order explosive to a slow-burning propellant. It is obvious that this set of conditions is highly variable and only through experimentation can the desired results be obtained, Schiffel added.

The deformation of the metal transpires in a matter of microseconds at 100 to 500 feet per second. There is extreme difficulty in analyzing what occurs in this short length of time. It has been found, however, that deformation is easier under a high rate of strain, rather than a low. Also at the point where the deformation is the sharpest, there is a sharp increase in the tensile strength of the material, this being a time and pressure characteristic. What really forms the metal, Schiffel asked? He answered his own question by stating that there are two conditions: pressure wave and shock wave. The majority favors the shock wave, but all agree that both pressures influence the condition.

The explosive must be of a predictable nature, and the stand-off or proximity is very important. One of the vagaries of the explosive is that, despite the same volume of charge, a varied effect of expansion will result because of its shape, Schiffel concluded.

—Don Massey

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SCHUYLKILL VALLEY—William Huyett, past chairman, presents gavel and block to newly installed Chairman Ray O. Heiser. Other new officers: William Woodworth, first vice chairman; Earl Westley, second vice chairman; Harold Olson, secretary; and George Cheri, treasurer. *—W. Robert Yeich*

Wichita Members Tour Hydraulics Products Plant

WICHITA—The regular May meeting of Chapter 52 took place at the Industrial Products Div., Cessna Aircraft Co., Hutchinson, Kan. The meeting was opened by Chairman William Unruh, who gave a brief summary of the recent Production Institute held at the University of Wichita. The hosts for the program were then introduced. They were V. H. Symthe, chief manufacturing engineer; his assistant, Ed Newman; and Leonard Rimer, project engineer, who described the evolution of engineering and development of the Cessna line of high-pressure hydraulic pumps.

Rimer began his narrative with a series of slides depicting, first, a simple hydraulic circuit. From this he progressed into the finer points of the Cessna gear pump.

Later the group was conducted through the plant. In addition to pumps the company produces approximately 425 different hydraulic items, such as control valves, cylinders and other components to equip complete hydraulic systems. *—Frank Dickerson*

Hamilton District

S. J. Soyka of Dow Corning Silicones, Ltd., spoke at the May 15 meeting with 39 members and guests present. Soyka's talk, illustrated by slides and moving pictures, centered on the application of silicones and moly disulphide lubricants in industry. Following a question and answer period, Past Chairman C. Bulmer presented a $400 ASTE scholarship to Douglas J. Mitchell, third year student of Hamilton Institute of Technology. A service pin was presented to Bruce Bone for fine service rendered as chairman of the program committee for the past year.

MUSKEGON—Past Chairman Jay Retsema congratulates new officers (left to right), Jack Jilek, chairman; Joseph Reddam, first vice chairman; Al Schrebe, third vice chairman; James Cook, secretary; and E. Huttenga, second vice chairman. Not present was the treasurer, John Chalko.

GM Tech Students Get Scholarship Awards

SAGINAW VALLEY—Each year Chapter 68 presents four scholarship awards to engineering students at General Motors Technical Institute in Flint, Mich. Three juniors and one senior are selected by the faculty of the school and the chairman of the chapter's education committee. This year Edward Reed of the National Education Committee was on hand to pass out the awards.

Receiving acknowledgment on the junior level were Warren Wells and Neil Johnston of Flint and Richard Leison of Saginaw. The awards consisted of a *Tool Engineers Handbook* and a year's membership in ASTE.

Lloyd Lee was the recipient of the senior scholarship award for his project entitled "An Investigation and Development of a Method for Producing Printed Circuits for Instrument Panels." A *Tool Engineers Handbook*, an ASTE pin, dinner tickets for one year, and a year's membership went to him.

Representative of the type of student the awards go to is Frank Faga, the present chairman of the Saginaw Valley chapter. Faga, in his student days, took one of the prizes from the chapter he now heads. *—A. P. Lind*

Communication Problem Studied at Springfield

SPRINGFIELD—Using five chapter members as his subjects, Christopher A. Barreca, manager of employer communication, education and training at General Electric Co., Pittsfield, Mass., demonstrated the fallacies that can creep into a story as it is passed on from one person to another.

The reason for this unusual demonstration lay in Barreca's claim that lack of clear communication between men and nations is "one of the world's big problems." Jones misunderstands his wife, the East misunderstands the West, management misunderstands labor, all because of poor communication, Barreca feels.

In his speech, "Communication—Bridge to Understanding," the speaker told the 85 members and guests that in today's world of uneasy peace there is a real need to convey messages in an honest, straightforward manner so that the contents can be clearly grasped.

The members from Pittsfield, 45 miles from Springfield, played host to the meeting. This gave the group an opportunity to tour the new General Electric Naval Ordnance plant in the area. *—Nicholas Latino*

Dozen 'Mature' Tool Engineers Celebrate 40-year Anniversary

Twelve mature-appearing men met at Detroit's Lee Plaza Hotel on June 5 for a banquet commemorating an event that occurred 40 years ago. They ate heartily, reminisced mightily, and in general gave testimony to the durability of tool engineers. As a matter of fact, they appeared fully capable of doing a better job than they did in 1919.

In that year, they and 24 other tool engineers comprised a tooling-up task force. The group was sent to Cleveland by the Cadillac Motor Co. to tool up the front and rear axles at the American Ball Axle plant. It was deemed a mission of great urgency to keep car production flowing. The men were quartered in the best hotels, feted and otherwise well-treated, and they responded by getting production started at the earliest possible moment. All in all, it was a memorable assignment.

A dozen of them got together 20 years ago to remember it. At that 20th anniversary banquet, which was reported in THE TOOL ENGINEER of August, 1939, the 12 men then present jokingly set the date for their next meeting—1959 seemed a long way off! Still they were able to gather an equal number this year, including five that were present at the 1939 banquet.

Those in attendance this year were Joe Butler and Charles F. Roush, sponsors of the reunion; C. Henry Clise, Clarence R. Davis, Charles W. Davis, F. V. Smith, Alvis Cusick, John A. Markstrum, Norman J. Martin, William N. Davis, William J. Fors and Carl Lewis.

Several of the original group could also reminisce about their roles in helping form the American Society of Tool Engineers, some 13 years after their Cadillac mission. Some started in engineering as early as 1910 and still are going strong. Of the 12 who gathered in Detroit this year, seven reported they are presently employed.

One of them, Norman Martin, drove to Detroit from Long Beach, Calif.

Aside from those who attended, eight others were contacted. They sent their regrets due to distance (one was in Florida, two others in California), work or other engagements. This indicates that 20 of the original 36—almost two-thirds of the complement—were in sufficiently good vigor to appear.

The banquet program this year was as informal as only such long friendships could make it. However, these observations were made during the evening:

None of the 36 had been airborne and fewer than 10 had driven a car up to 1919. . . .

Automation, television, nuclear fission and fusion were unknown. . . .

Public officials counted on their fingers and could pay for what was needed in 1919, while today they rely on electronic digital computers to tell them that we are broke. . . .

For the decade following 1919, the entire annual national budget was less than what is expended on bewildered farmers today. . . .

After a short and serious discussion, the group decided not to schedule another meeting for 1979—although it may be possible, tool engineers being what they are!

—John A. Markstrum, Charter Member ASTE

C. J. Black, president of Los Angeles Harbor Junior College, delivers welcoming remarks at the first on-campus student conference.

Coast College Is Site of First On-Campus Student Conference

The ASTE's first on-campus conference devoted to students interested in tool engineering took place at the Los Angeles Harbor Junior College, Wilmington, Calif., on June 13. The Centinela and Long Beach chapters helped set up the presentation, designed especially for high school and junior high students.

Harbor College president, C. J. Black, officially welcomed the group composed of ASTE members, educators, industrialists, and potential tool engineers after the meeting was called to order by Larry Pomerantz, past Long Beach chapter chairman. Ray Gariss of Long Beach, vice chairman of the National Technical Publications Committee, then offered the group an "Introduction to Tool Engineering." He assured the students of the need for tool engineers by revealing that 96 percent of labor is done by machines. This type of production has reduced the cost of manufactured products seven times. He elaborated somewhat on present-day planning and production by saying 42 major decisions are needed to produce a simple mechanical pencil.

In an education-industry panel discussion, the college was represented by Dr. John Grasham, moderator and dean of instruction; Hazel M. Whedon, administrative dean; and John Quier, instructor. The industrial viewpoint was covered by E. J. Van Wagner, general supervisor of tool design, Douglas Aircraft Inc., Long Beach Div.; A. S. Turner, chief tool engineer, Northrup Aircraft; and R. C. Evans, chief tool engineer, Arrowsmith Tool & Die Corp.

The panel informed the students of the requirements of training and ability, and the advantages and future possibilities that go with a career in tool engineering.

Keystone

At the May 18 meeting ASTE national scholarship awards were presented to two local area students: Theodore J. Tomaszewski, a Pennsylvania State University student; and John Raymond Krzezewski of Penn. State University. After the presentation 40 members in groups of 8 made a tour of the Consolidated Molded Products Corp. injection molding plant, with Robert Coyne, production manager, acting as host and explaining operations of the machines.

Boston

At the May 14 meeting S. C. Zylstra, chief chemical engineer, of the D. A. Stuart Oil Co., was the guest speaker. His topic was "Modern Soluble Oils" and in his presentation he considered a great many of the latest developments and techniques of coolants used in today's manufacturing processes. Numerous samples of the oils discussed were typed and on display and the members showed their interest and appreciation during a question and answer period.

St. Louis Speaker Fears New Seaway Is One-Way Street

ST. LOUIS—Carl Weber, director of research at Laclede Steel Co., declared in a speech to the chapter here that the big majority of ships using the new St. Lawrence Seaway are those coming in loaded with foreign products. "Is the Seaway nothing but a one-way street?" he asked.

If it is, Weber continued, it is a threat to our economy and standard of living. Such one-way traffic is a threat to the fine balance we have maintained in this industrial nation despite the wage-price rise, he said.

Weber told his Ladies Night audience that the United States is producing 120 million tons of steel per year, 90 percent of this for civilian use and 10 percent for military. In contrast, Russia is producing 60 million tons a year, with less than half of it for civilian purposes. An average American family uses three tons of steel per year. And if the country is in need of more steel it can easily produce it, Weber pointed out, since the maximum capacity today stands at about 146 million tons per year.

"This is balance," Weber said. "Yet imports threaten to throw our economy off balance. Foreign countries don't maintain this balance, therefore they must sell their goods elsewhere.

"We must, through individual effort, concern ourselves with these problems. We can have free trade but it must be equalized. We can equalize the labor differential by adding tariffs on imports and by so doing we may be able to make the Seaway a two-way street."

He said that production and labor costs abroad vary widely but are generally much less than in this country. As an example, he asserted that autos are produced at a labor rate of about four to one. —*Lyle R. Perry*

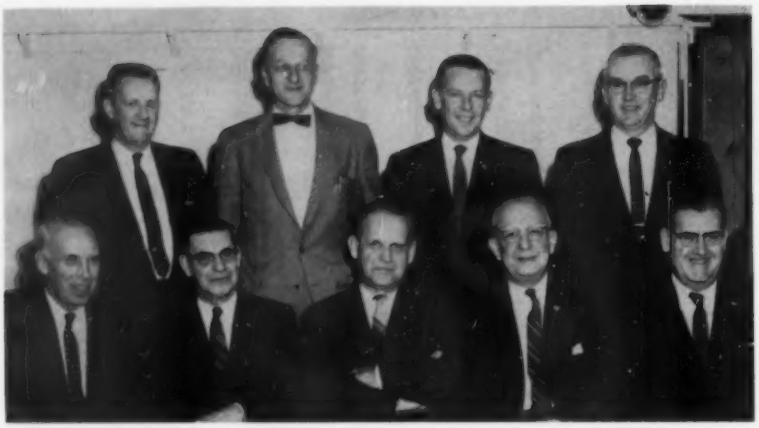
Fond du Lac Tours Great Lakes Ship

FOND DU LAC—During a recent tour of the Manitowoc Shipbuilding Co., 95 members and guests of Chapter 45 inspected the largest self-unloading ship ever built on the Great Lakes. The 666-foot, $15-million ship, called the Adam E. Cornelius, can unload some 16,000 tons of coal or limestone in five hours, using the self-unloading equipment built into the ship. The tool engineers were told that a million man hours, including over 75,000 engineering hours, were required to build the vessel. —*Roland Hecker*

SAN FRANCISCO—Inspecting products of Dalmo Victor Div., Textron, Inc., of Belmont, Calif., is Chairman Frank L. Sweet, with guide, Plant Manager Cazmo Luckrich. More than 200 members and guests visited the pioneer electronic firm whose specialty is radar antennas.

BRADFORD-OLEAN—Swearing in the charter officers of Chapter 158 at ceremonies May 11 is National President Wayne Ewing (right). The officers are (left to right) Treasurer Robert Mullen, Secretary Bill Kresge, Second Vice Chairman John Vitale, First Vice Chairman George Cunningham, and Chairman Jack Kamerer. The new chapter in the Pennsylvania-New York border area was launched with 86 charter members. —*C. H. Miller*

HARTFORD—Chapter 7 has announced winners of scholarships totaling $900 per year for five persons. Pictured here are four of the winners (top row): L. F. Bowen (Hartford University); N. Ladutko and B. W. Henry, Jr. (State Technical Institute); and G. Jaculczak (University of Connecticut). Seated are Dr. A. H. Zurban of Hartford University, James Mead of State Tech, and Dr. C. H. Coogan, Jr., U. of C. The fifth winner, F. D. Mollor, Jr. (Hartford U.), was not present. *G. S. Haviland*



WORCESTER—Nine past chairmen showed up for a recent technical meeting of Chapter 25. Seated left to right are Ralph E. Rawling, Ralph A. Baker, Victor H. Ericson, Carroll L. Morse, Albert T. Warman; standing, G. Roland Ljungquist, Adam T. Kosciusko, John C. Lalor, and John E. Rotchford, who is also past chairman of the National Standards Committee. —*Robert A. Cusson*

Standard's Acceptance Credited to ASTE and IDA

PATERSON—The work of the American Society of Tool Engineers and the Industrial Diamond Association paid off in the case of Standard B67.1. Diamond Dressing Tools. The credit for its acceptance goes primarily to these two organizations, whose study and finalization made it a reality. Word of the new standard was announced at the June meeting of the Paterson chapter. A member of this chapter, Margaret J. McGinnis, is also the executive manager of the Industrial Diamond Association, therefore she felt doubly proud of the feat.

The June 1 meeting also featured a talk on wire and the products made from wire by T. W. Whipple, vice president of sales at E. H. Titchener & Co., Binghamton, N. Y.

Talk on Gun Drilling Delivered at Dayton

DAYTON—William Holloway, director of research and development projects at Madison Industries, Inc., Muskegon, Mich., covered every conceivable aspect of "Modern Gun Drilling Techniques" in his talk at the April technical meeting before 100 members and guests.

The history, applications and performance features of gun drilling headed his talk. Then came reamers, replaceable head drills, approximate speeds and feeds, coolants, approximate pressures and viscosities, adequate filtering, piloting, and regrinding—all clarified by means of charts and other data provided by Holloway.

As an added incentive to attend the meeting, a *Tool Engineers Handbook* was presented to a surprised member. Also on the agenda was a film on the "Yankee Toolmaker" produced by the Bullard Co. —*Ralph E. Frederick*

DECATUR—1959-60 officers of Chapter 58 are (left to right, front row): James Hofstetter, first vice chairman; Don Bess, chairman; Harold Baker, second vice chairman; (back row): William Bahnfleth, past chairman of Peoria chapter who installed the officers; Kenneth Hurt, outgoing chairman; William Hayer, secretary; and Charles Bergin, treasurer. —*Kenneth D. Hurt*

LOS ANGELES—George Adams (left), treasurer of the Los Angeles chapter, presents that group's fourth annual scholarship award consisting of $250 to California State Polytechnic student, Donald W. Gunn. Looking on are student chapter faculty adviser, Francis Whiting, who is dean of engineering at California Polytech, and Student Chapter Chairman Jesse Crews.

Tool Engineer Merry Dies in Connecticut

HARTFORD—Arthur A. Merry, chief of advanced tool engineering at Pratt & Whitney Aircraft Div., United Aircraft Corp., died at Hartford June 12. He was 67.

An ASTE member and a leading tool designer, he had supervised the development of tools used in aircraft production since joining P&W in 1940. Prior to that time, he was with Excello Corp. for two years and with Carboloy Co. for 10 years, until 1938. He operated his own machine shop for four years, and in addition had been affiliated with General Electric for 10 years and Bucyrus-Erie Co. for four years.

Second Summer Seminar Concluded at Utah State

LOGAN, Utah—The second annual Tool Engineering Summer Seminar, a week-long program, has just been concluded at Utah State University here. Under auspices of the university's Department of Tool Engineering, which is headed by Prof Frederick Preator, the seminar put special emphasis on the newer exotic materials and the applications of plastics in tooling.

Seventeen participants heard a team of research manufacturing engineers from the Boeing Airplane Co. In addition, they attended ten lectures dealing with management problems in job evaluation, the building of a wage structure, and fringe benefits, presented by Prof. L. C. Pigage, University of Illinois.

Position Wanted

MANUFACTURING PROCESS ENGINEER SR.—with nine years' experience. Would like new surroundings. Will relocate anywhere, preferably in Michigan. Experienced in sheet metal stampings. Write to: Box 156, ASTE News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

Positions Available

OPPORTUNITY FOR ENGINEER—to direct machine tool laboratory in well-equipped Midwest university. Work involves teaching and course development. Research encouraged. Prefer man with advanced degree who is oriented to a study of the fundamentals of metal cutting and forming, and to the generation of technically important shapes, rather than to the training of mechanical skills. Write to: Box 154, ASTE News Department, The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

DIE DESIGNER—and a DIE FOREMAN experienced in jobbing shop procedures. Write to: Box 153, ASTE News Department, The Tool Engineer, 10700 Puritan, Detroit 38, Mich.

DENVER—Vice President (now President) Wayne Ewing stopped to discuss chapter's outlook for new year with Chairman John Nosler after installation ceremonies. —*Milton J. Haney*

SPECIAL EVENTS

ASTE Semiannual Meeting	Oct. 8-10, 1959	The Chase-Park Plaza Hotels St. Louis, Mo.
ASTE 28th Annual Meeting	April 21-28, 1960	Statler-Hilton and Sheraton-Cadillac Hotels, Detroit.
ASTE Tool Show	April 21-28, 1960	Detroit Artillery Armory.

SOUTHERN TECH—National Director Frank F. Ford congratulates new officers of the "live-wire" Southern Technical Institute student chapter at Atlanta: Joe Fishback, chairman; W. F. Slappy, second vice chairman; George M. Jackson, secretary; and C. E. Bannister, first vice chairman. Treasurer Robert Miller was absent. —*G. M. Jackson*

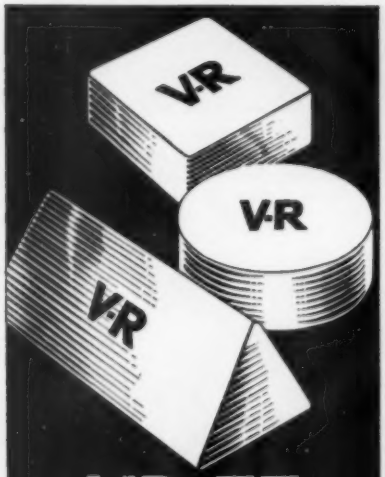
TWIN STATES—Posing after installation meeting at Springfield, Vt., are (left to right) Leroy H. Lindgren, retiring chairman; David E. Armstrong, chairman; Charles F. Chandler, second vice chairman; Michael J. Knoras, secretary; and William A. Hebert, treasurer. Absent was Glenn D. Easton, first vice chairman. —*B. W. Harriman*

OAKLAND COUNTY—New officers of Chapter 69; Lyle J. Hope, chairman; Emerson Brown, first vice chairman; Charles T. Gaffney, second vice chairman; Neil C. Martin, secretary; and Walter H. Morris, treasurer. —*Edward Teal*

You wouldn't play right field with a catcher's mitt . . .

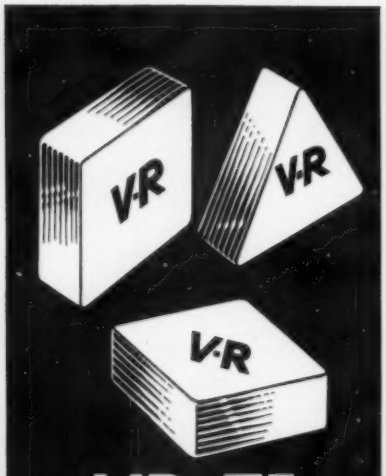
playing ball or cutting steel,

use the "tool" designed for the job!



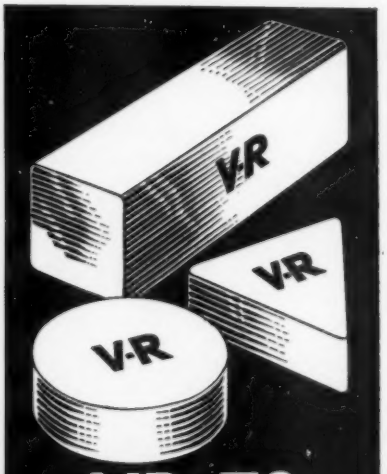
VR-77

for heavy roughing and interrupted cutting



VR-75

for medium roughing and general purpose machining



VR-73

for finish machining and light roughing

Each carbide grade has been specially engineered and field proven for the correct balance of wear resistance, shock resistance and heat resistance to handle a specific range of operations. These superior V-R carbide grades cover the complete range of operations for machining all types of steel and the new superalloys . . . setting new standards of carbide tooling performance in hundreds of plants. V-R engineers will be glad to help you select the carbide grade engineered for your job. Contact your nearest V-R representative or write for complete information.

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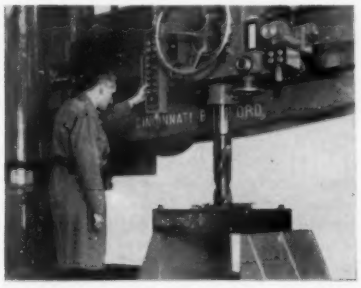
Progress in Production

MASSIVE MACHINE DRILLS FIVE-INCH HOLES

Holes in workpieces up to nine feet high can be drilled by Thrustmaster drilling machines built by Cincinnati Bickford. The first two of these machines have 10-foot arms, 9-foot clearance under the spindles and weigh 80,000 lb. They will be used for drilling and backfacing operations on turbine housings.

Great versatility for a wide range of work is provided by 32 speeds in one of two ranges: 6 to 875 and 9 to 1300 rpm. Feeds range from 0.004 to 0.125 ipr and tap leads are 8-10-11½-14-20-27 threads per inch.



Drilling a five-inch diameter hole in solid steel on a Cincinnati Bickford radial drilling machine.

Diameter of the spindle is 3½ inches; spindle travel is 28 inches. Power for heavy drilling loads is transmitted smoothly to the spindle through a large herringbone driving gear. When high-spindle speeds are desired, the herringbone gear is declutched and the drive is then through a smaller spur gear. This eliminates the usual flywheel effect. The drive motor is 50 hp.

Complete preselection of feeds and speeds is possible while the spindle is running. Feeds are selected by a rotary valve, manually positioned. Speeds are selected by an electrical switch that controls a series of solenoid valves.

ROTARY INDEX MACHINE USES STANDARD COMPONENTS

Standardized modular components, including a 60-inch diameter table, with fluid drive index mechanism, wing bases, vertical columns, way type slide units, milling heads, drill heads and tapping heads with leadscrew drives, are incorporated into a five-station rotary index machine designed and built by Snyder Corp.

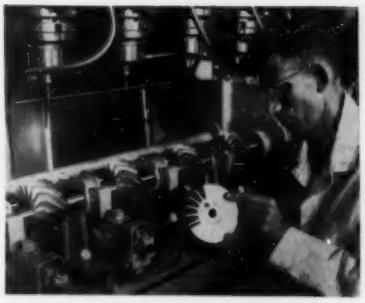
The machine mills, drills, countersinks, spotfaces and taps the carburetor pads in three different truck engine intake manifolds. Production at 100 percent efficiency is 109 pieces per hour. Three interchangeable pot type heads permit accommodating different numbers and sizes of holes for each part design, giving good versatility.

Rotary index machine performs numerous operations on carburetor pads. Modular machine components give maximum flexibility.

FOUR-AXIS MILLING SPEEDS BLADE MACHINING

Complex multibladed turbine wheels that once required 24 hours to produce are now completed over 40 times faster by a new system developed at the Boeing Industrial Products Div.

These inducer wheels, used in gas



Turbine wheels are milled four at a time on self-guided milling machine. Special hydraulic controls have been added so that complex curves can be generated at high speeds.

turbine engines, are set into the front of the engines to guide air into the compressor. This is accomplished by high-speed rotation of special blades.

Production formerly required a double process: one step to produce the wheels with flat blades; a second process to attain the complex and slightly curved blade shapes necessary.

Boeing tool engineers solved the problem by adding special hydraulic controls to the selfguided milling machine on which the wheels are completed in one operation.

Ordinarily, this machine can operate in only three axes—cutting horizontally, vertically and in depth. The new system adds a rotational feature that permits changing the angle of the blades while being milled.

The milling machine, producing four wheels simultaneously, completes the entire machining job in a half-hour.

MINIATURE PARTS INSPECTED BY X-RAY

Nondestructive inspection of miniature electronic components such as resistors, crystal diodes, photoresistors, ceramic capacitors, transistors, thermistors and other encapsulated parts has been made possible by development of

V&O
LONG
SLIDE
PRESSES

STILL
the most inherently accurate inclinables you can buy—and so the most logical for mechanized or automated operations.

Emhart Manufacturing Co.
Hudson, New York
V & O Presses and Feeds

EMHART

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X-ray photomicrograph of diode rectifier clearly shows details of internal construction; gives positive check.

a filter technique to aid taking sharp photographs with an X-ray microscope. The technique was developed by Chicago Apparatus Co.

The time required for such photographs, using the Polaroid Land camera supplied with a General Electric X-ray microscope, is from five to ten minutes. Magnifications up to 200X are possible, permitting the inspection of fine detail such as microwelds. Dimensions of internal features can be computed in proportion to the enlargement of measurable external features.

MULTIPLE-SPINDLE MACHINES PERFORM 247 OPERATIONS

Production of frames for dictating machines has been expedited at Dictaphone Corp. by a change from gang drill production to a line of eight high-speed, multiple-spindle Natco machines and three milling machines. Seven of the machines are standard drilling and tapping models; the other is a two-way machine, converted to a one-way.

One operator can tend several multiple-spindle machines for production of dictating machine frames. Savings are $1 per part over previous gang drilling methods, production is faster.

A total of 97 holes, ranging in size from ⅛ inch to ½ inch in diameter, are drilled on these machines. Some 150 secondary operations—reaming, tapping, counterboring and countersinking—are also performed.

The 10 x 9 x 2 in. magnesium castings are stress-relieved before machining.

Machines are grouped to operate together or independently of each other. Parts are banked at each machine and production can be continuous or intermittent, with one operator tending several machines in sequence. This flexible arrangement permits the line to match variations in production schedules.

All machines can be easily shifted on the floor as required for production change-overs and tooling has been designed for fast installation and removal, making it possible to use the line for production runs of replacement parts of earlier models.

PRECISION DIE CASTINGS ELIMINATE ASSEMBLY OPERATIONS

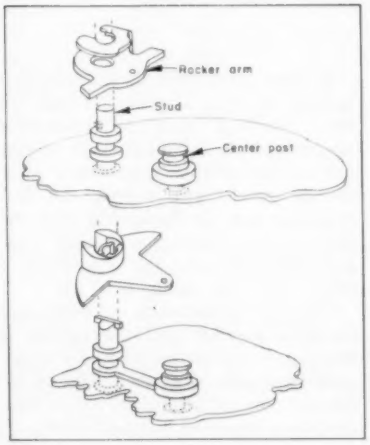
Sizable savings have been achieved by Clarostat Mfg. Co., manufacturer of small switches, by replacing tiny stamped and machined parts with precision die castings made by Gries Reproducer Corp. Since these switches are assembled from small, intricate parts, labor costs were high and it was essential to eliminate as many production and assembly operations as possible.

Originally, important moving parts of the switch—the rocker arm, the stud and the post—were made by methods other than die casting. The rocker arm was a stamping and the other two parts were made in screw machines.

Initial studies showed that cost savings were possible by die casting, rather than machining, the stud and the post. However, these savings were minor compared to the savings made possible by combining the two components into one part. The new part cost 53 percent less than the two parts it replaced.

An additional benefit was realized in

In old design (top) stud and center post were produced individually on a screw machine. Rocker arm was a stamping. With new design (bottom) stud and centerpost are combined in one die cast part and rocker arm is also die cast. This design minimizes part and assembly costs.

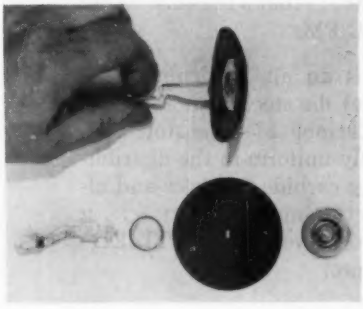


subsequent operations. Since all of the combined parts are produced in the same die cavity, all castings are dimensionally uniform. This uniformity makes possible automatic assembly of the finished switch.

ASSEMBLY MACHINE SPEEDS PRODUCTION

Five components of an automobile distributor vacuum contact are automatically assembled at the rate of 900 or more units per hour on a machine manufactured by The Sheffield Corp. Components—an arm, a washer, two diaphragms and a retainer ring—are shown in the illustration.

Briefly, the assembly operation is as follows: the arm is placed on a receiver that transfers it to the first assembly station. Here a hopper-fed washer is automatically placed on the arm. The assembly is then transferred to the next station and the diaphragms, automatically blanked and pierced from two separate rolls of rubber fabric, are added. Following this, the assembly is indexed to the next station where the retainer ring is added and staked. The final operation is to coat the staked spot with sealing compound.



Components for an automobile distributor vacuum contact are assembled automatically on a special Sheffield machine.

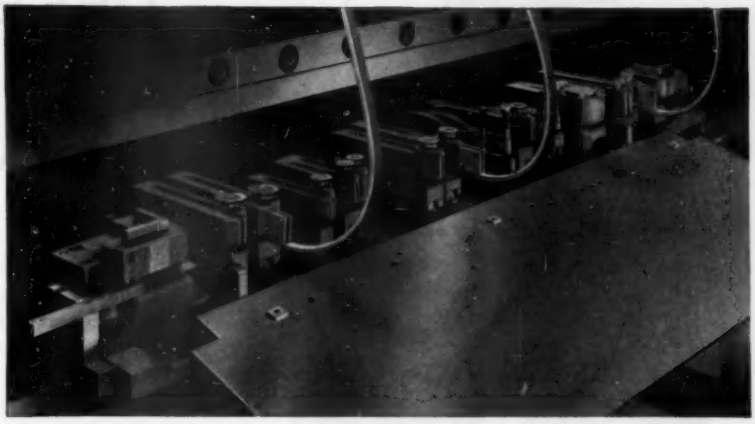
A preventive maintenance and timing system is built into the machine, allowing quick connection of a sequence time recorder through a standard receptacle.

The machine accommodates three different size arms.

Suppliers Directory

The Suppliers Directory included in the June 15 issue of the TOOL ENGINEER makes it possible to quickly get in touch with the local representatives of all manufacturers of machines, tools, tooling and supplies.

NEW
STRIPPIT UNITS
. . . stake nuts permanently
with every press stroke !



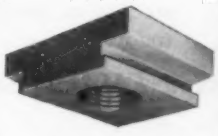
STRIPPIT PIERCE NUT UNITS save operations, time and money in assembly panel production with single-stroke insertion of Fabristeel Multipierce Nuts* into sheet metal up to .125" thick.

Permanent Fastening by an Exclusive New Process—as nut pierces stock, metal flows into nut shoulder slot, becoming an integral part of the stock.

High-Speed—fast press setups, automatic feed of nuts to units for long, medium or short runs gets maximum production per press.

Flexibility—Pierce Nut Units can be quickly press-mounted in any desired pattern, changed on short notice, re-used over and over.

*A Product of Fabristeel Products, Inc.



Each nut is its own punch, a new one each time

Die button causes material to flow into nut slot

Simultaneous embossing for flush fastening

WRITE FOR DEMONSTRATION on your press ! The speed and simplicity of Strippit Pierce Nut operation has to be seen to be believed. Also request new catalog for complete specifications.

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211 Buell Road, Akron, New York
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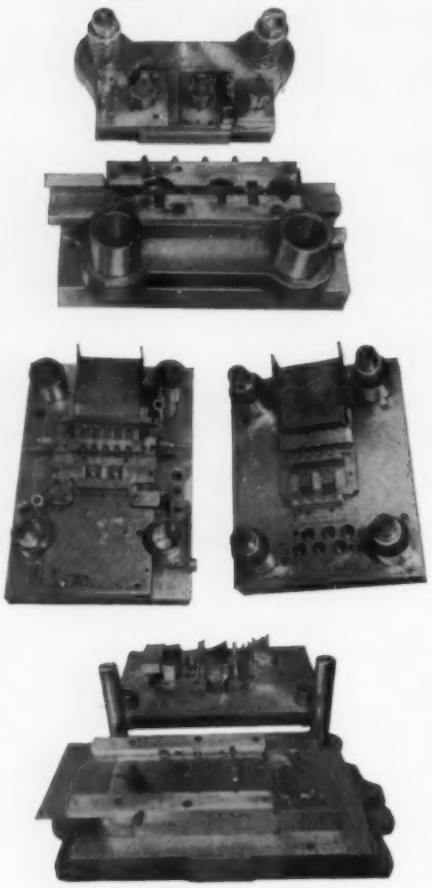
Produced by LATROBE for long-run dies...



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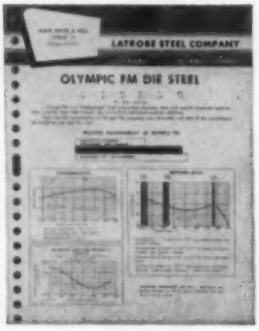
Free-Machining
DESEGATIZED®
OLYMPIC FM
High Alloy Die Steel

When your die production calls for long-run service . . . and you need a die steel that yields a superior machine finish without tearing—one that has excellent non-deforming characteristics in heat treatment . . . that's the time to use Latrobe's OLYMPIC FM.

OLYMPIC FM is an air hardening 12% chromium (D-2 type) die steel made to exacting standards by Latrobe Metalmasters . . . guaranteed to be fully-uniform in the distribution of wear-resisting carbide particles and alloy sulphides for better machinability . . . a result of Latrobe's exclusive DESEGATIZED® process of manufacture!

There's a wide range of Olympic FM sizes stocked at branch warehouses near you—Call today!



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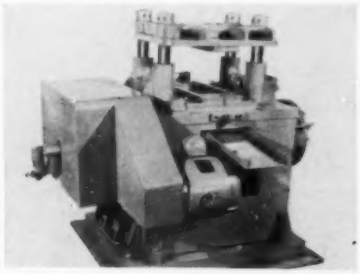
TOOLS of today

Flying Die Press

High-speed production in cutting-off or prenotching roll formed materials is possible with the Model 5-D heavy duty flying die type press. Use of this type of press permits utilizing coil stock instead



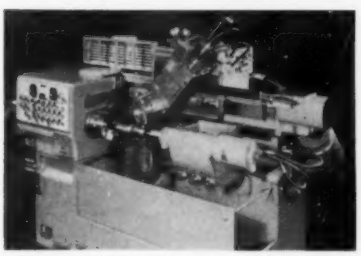
of cut lengths, reducing scrap and resulting in the production of more uniform shapes. Operating speed is 300 rpm; capacities are 4 to 120 tons.

Dahlstrom Machine Works, Inc., 4227 W. Belmont Ave., Chicago 41, Ill.

Circle 350

Tracer Lathe

Three roughing cuts and a finish turning cut can be made from the same template, using the Model 14T-25 multicycle tracer lathe. The lathe is designed so that stylus and cutting tool are closely coupled to reduce the possibility of deflection and other errors.



Graduated scales are provided for dog setting, template positioning, tailstock positioning and crossfacing slide location. Dial indicators at the top of the tracing carriage permit accurate depth setting of the first three cuts. After the three roughing cuts are taken, the tool turret indexes for the finishing cycle with a 0.020-in. depth of cut. This arrangement makes it practical to use carbides for the first three cuts and finish with ceramics if desired.

Spindle speeds from 340 to 3100 rpm are offered with a two-speed head; a four-speed head permits speeds from 225 to 3100 rpm.

Sundstrand Machine Tool Div. of Sundstrand Corp., Belvidere, Ill.

Circle 351

USE READER SERVICE CARD ON PAGE 145 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Electrical Discharge Machine Tools

Extrusion dies, powder metal dies, cold heading dies, blanking dies, multiple pierce dies and three-dimensional cavities can be produced by electrical discharge machines in the RP-100 series.

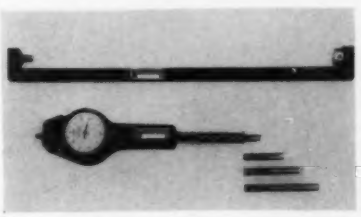
Worktable surfaces are 7 by 17 or 12 by 18 in. A 3¼-in. diameter quill travels 10 in. vertically. A dielectric oil system consisting of reservoir, pumps and filters is built into the base of the machines, which are built to JIC standards. Floor space requirements are 27 by 61 in.

Elox Corp. of Michigan, 1830 N. Stephenson Hwy., Troy, Mich.

Circle 352

Dial Pin Gage Kits

Straight bores, groove and pitch diameters, slots, reliefs and partial contours can be checked with kits designed for checking large internal diameters. Kits are available for 6-12 inch, 12-18 inch and 18-24 inch diameter ranges. Settings can be made to any dimension within the range of the gage. The master is set with Jo-blocks and the gage in



turn is set to the master. A minimum number of range extensions are required.

Boice Gages, Inc., Hyde Park (Dutchess County), N. Y. **Circle 353**

Looping Attachment

Designed for forming a machine loop on extension springs, an attachment makes coiling and looping fully automatic. This attachment is used with a No. 3 universal spring coiler, escapement type. The transfer mechanism of the unit has a small claw that spreads one coil from the body of the spring so

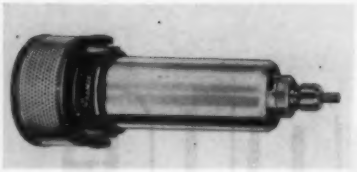
that when the spring is carried back into position for last-end looping, the tools are sure to enter properly.

Tests have been conducted through a range from 0.010 to 0.020-in. wire; future tests may establish a wider range of possible wire sizes. Springs having ⅛ to 5/16-in. diameters have been successfully looped. Normal production is about 50 springs per minute.

Sleeper & Hartley Inc., 335 Chandler St., Worcester 1, Mass. **Circle 354**

Power Quill

Model Super 70 high-speed power quill is intended for precision mass production of small electrical and electronic components. Collet capacity is ⅜ in. and load speeds are from 15,000 to

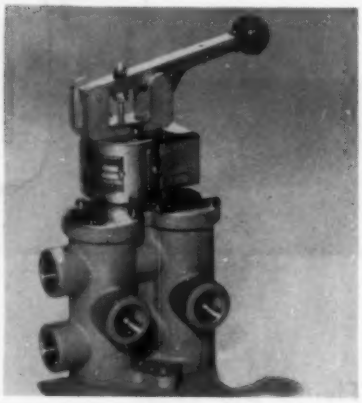


35,000 rpm, with a ¾-hp motor. The entire unit is self-contained. It is equipped with Vari-Speed control. A meter, calibrated in rpm, permits accurate control of machining operations.

Precise Products Corp., Racine, Wis. **Circle 355**

Solenoid Air Valve

Since it can be actuated by hand, whether the coil is energized or de-energized, this Crescent solenoid valve is suited for all low-pressure air systems (to 150 psi) where manual control



is part of normal production set-ups, or where it is needed for emergencies only. Electrical and operational failures in the system can be easily checked without the need for halting production.

Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Calif. **Circle 356**

Air-Powered Router

Partial or complete cuts through metals, plastics, woods or honeycomb materials can be made with a portable router. Open construction of router base

provides a clear view of the cutting operation. The air exhaust is directed downward across the router bit to expedite chip removal.

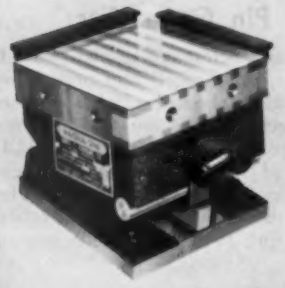
Buckeye Tools Corp., 5033 Springboro Pike, Dayton, Ohio. **Circle 357**

Pneumatic Face Mill

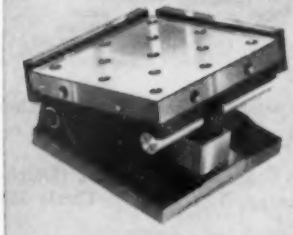
Air-operated, this Luft Line face milling unit is designed to perform facing or milling operations in any position. The machine can be brought to the job. It is particularly adaptable to large assem-

NEW
SMALL SIZE

LOWER COST, FASTER ACCURATE ANGULAR SET-UP OF SMALL WORK



Magna-Sine (Model B-3-MS)
With 4" x 4" Working Area



Sine Plate (Model B-3-SP)
With 4" x 4" Working Area

ROBBINS MAGNA-SINE

This new smaller Magna-Sine has all the time-saving, accurate angular set-up features found in larger Robbins Magna-Sines. Small to medium size work can now be set up in minutes instead of hours and with a lower investment in equipment. Magna-Sine table has a strong, fine pole, permanent magnet chuck that firmly holds small work without distortion.

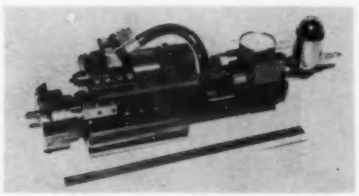
ROBBINS SINE PLATE

Robbins small Sine Plate is manufactured to the same high standards of accuracy as the Magna-Sine. This precision makes it ideally suited for angular inspection set-ups. The ground surface of the non-magnetic table has tapped holes for convenient clamping of any work. Also, sturdy construction makes this small Sine Plate extremely suitable for light machining operations.

Compound angles are quickly and easily set up with this Robbins equipment by combining either two Magna-Sines, a Magna-Sine with a Sine Plate, or two Sine Plates. Now, with lower initial investment, every shop can secure accurate angular set-ups for small work. With Robbins equipment, you do a better job, faster and at less cost.

OMER E. Robbins COMPANY
11961 DIXIE AVENUE DEPT. E DETROIT 39, MICH.

USE READER SERVICE CARD, CIRCLE 33

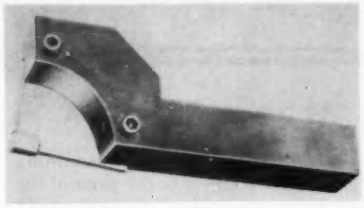


blies that have an area to be milled or faced that can be encompassed in a three to five-in. diameter. The facing head feeds automatically at the rate of zero to 0.015 ipr. Length of the machine in 18.5 in.; width is 3.5 in.; height is 5.375 in. Motor is of the vane type.

Automation Tools Inc., Box 331, La Jolla, Calif. **Circle 358**

Cutoff Tool

For use on turret lathes and automatic screw machines, the Non-Flex cutoff tool has a heavy, hardened steel support directly below the cutting tip. This provides extreme rigidity for cutting at

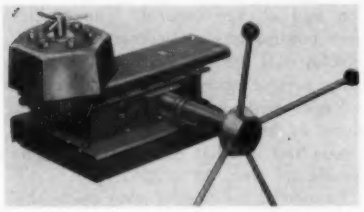


high speeds. The tools are made in four sizes for 2½, 3½, 4½ and 6-in. maximum bar stock diameters.

General Machine Co. Inc., Emmaus, Pa. **Circle 359**

Turret Attachment

Model 400 AK bed turret is designed for lathes in the 13 to 18 inch range. It

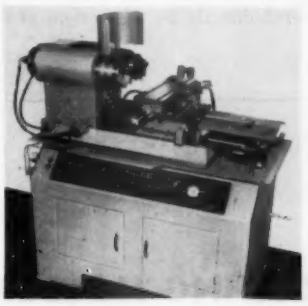


converts engine lathes to ram type turret lathes, capable of multiple machining operations. The self-indexing six-station head is mounted on a 5-deg tilt. This gives an increased clearance of the tool over the slide when the head is rotated. Ram length is 20½ inches. All tool holes are left blank for machining after the turret is mounted.

Precision Processing Co., 3269 Casitas Ave., Los Angeles 39, Calif. **Circle 360**

Boring Machine

Twin-spindle automatic cycling boring, turning and facing machine is designed to perform a complete finishing operation on a blank in one cycle. While the front of the workpiece is being machined on one spindle, the reverse side can be finished on the other. The Boreking is capable of repeating to a tolerance of 0.0002 in. on a facing cut and 0.00005 in. on boring.



Two air motor units allow for independent adjustments of the main table and cross slide feed. Spindle speeds are infinitely variable between 400 and 4000 rpm. Drive is from a single ¾-hp motor.

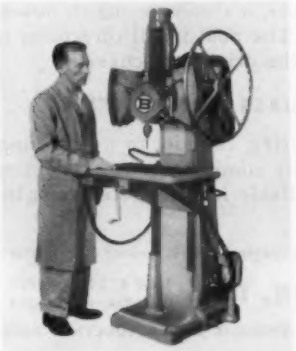
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y. **Circle 361**

USE READER SERVICE CARD ON PAGE 145 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Turret Drilling Machine

Power indexing turrets have been provided on the Burgmaster 1 C Model, which has ⅜-in. drill capacity in steel. A heavier, simpler transmission and clutch assembly drives the six spindles.

There are 12 preselected spindle speeds, ranging from 325 to 4050 rpm. Each spindle is set to operate at the cor-



there's **power** to spare in O-M heavy-duty **Hydraulic** (oil) **Cylinders**

Series TH
2000 psi operation
3000 psi non-shock
Available in 1½" to 8" bores
Meet JIC Standards

IF you need smooth, dependable straight-line motion for heavy-duty pushing, pulling, elevating, lowering, clamping or knock-out operations, these powerful, O-M components have what it takes and more, too. To deliver this plus in power, every essential design and construction feature has been employed.

For example, these units are ruggedly constructed of heavy wall seamless steel tubing microhoned to minimize friction. The ports are large and unrestricted. They can be located at 90-degree positions. These cylinders are sealed right to prevent power loss. The piston rod is stress relieved, turned, ground and polished, high tensile steel, chrome plated. In addition, the rod gland cartridge, accurately piloted in the rod head to assure perfect alignment, is easily unscrewed and removed. Pilot O.D. of cartridge serves as pilot for cylinders mounted on rod end. A cushion ball check valve provides for rapid, full power start of return stroke.

These and many other advancements are described in our latest catalog No. 105. Write for your copy TODAY or consult your local O-M representative.

ORTMAN-MILLER MACHINE CO.
13 143rd Street, Hammond, Ind

☐ Have representative call
☐ Send Bulletin 105

Name_____ Position_____
Company_____
Address_____
City_____ Zone___ State_____

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rect speed for the operation. Precision depth control is also provided for each spindle.

The machine is equipped with a 14 by 24-in. table. Spindle travel is seven inches and maximum clearance from spindle nose to table is 28 in. A one-hp motor is used.

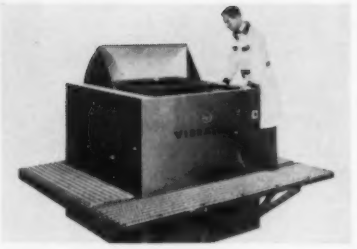
Burg Tool Mfg. Co. Inc., Gardena, Calif. **Circle 362**

USE READER SERVICE CARD ON PAGE 145 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Vibratory Barrel Finishing

Vibratory machine is for mass production cleaning, descaling, deburring, radiusing, fine finishing and coloring of metal parts. Complex cast, forged, stamped and machined parts with shielded and internal surfaces are finished at rates 1000 percent faster than with conventional rotating barrel finishing machines.

Vibration is induced by a system of eccentric weights integrally mounted within the vibrating motor. The motor is mounted directly on the bottom of the



vibrating tank. No fluid couplings, clutches, V-belts or chains are required. A variety of machine sizes are available.

Roto-Finish Co., Kalamazoo, Mich. **Circle 363**

SEIBERT FLOATING HOLDER

Compensates For Misalignment Of Tool And Hole

MORSE TAPER SHANK — Others available.
EXTRA BEARING CAPACITY—Withstands heavier thrust loads.
COLLET-CLOSING RING—Provides for quick tool changes.
SEIBERT & SONS CHENOA, ILL.

- ECONOMICAL
- CONVENIENT
- EFFICIENT

Continues to Float Freely when Tool is at Work

This holder, one of a long line of SEIBERT fine machine-tool accessories, provides a full float to compensate for misalignment of hole and tool when such operations as drilling, tapping, and reaming are performed. It also provides for holding close tolerances, it eliminates much downtime, and it permits quick tool changes. The float in all directions is not hampered by friction or binding in the driving mechanism.

HEAVY-DUTY DESIGN ASSURES LONG LIFE

The heavy-duty design provides extra bearing capacity to assure long life, and the positive lubrication practically eliminates wear and parts replacement. All types of shanks are available in a range of sizes, including an adjustable adapter shank.

Send for complete specifications and price information.

SEIBERT

SEIBERT & SONS, INC. 1003 E. 24th STREET CHENOA, ILLINOIS

Quality MULTIPLE DRILL SPINDLES AND PRODUCTION TOOLS

USE READER SERVICE CARD, CIRCLE 35

Chip Breaker Drill

Penetration up to 12 times drill diameter without withdrawal is possible with Speedicut Chipbreaker drills. Web is constant over the entire length of the flutes. Long spiral chips are eliminated

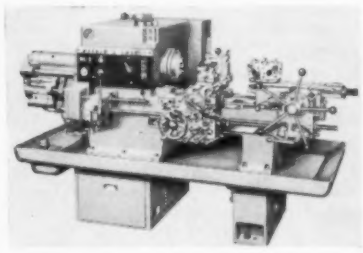
by a chip breaking web, permitting coolant to flow freely to the point of the drill for maximum heat dissipation and nonclogging performance. Sizes are from ¼ to 4 in.

Speedicut Div., Chicago Heights Steel Co., Chicago Heights, Ill. **Circle 364**

Universal Turret Lathe

Designed to handle bar work up to 1½-in. diameter, this turret lathe has an eight-speed, all-hydraulic clutch headstock plus single-lever speed preselection and change control. The single-lever control has a direct-reading preselector dial that tells the operator the exact surface speed for each diameter and rpm, with numbered clips showing where to find each of the preselected speeds and in what order to use them. Speeds are from 90 to 2262 rpm.

A touch of the control lever opens the collet and feeds the bar (up to seven



in.). The hydraulic collet chuck and bar feed mechanism provides extra support and rigidity needed for high-speed operation.

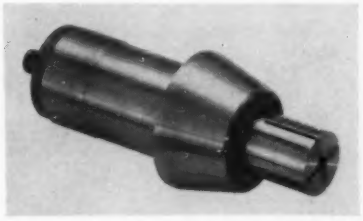
Cross feeds range from 0.0025 to 0.026 in.; longitudinal feeds from 0.003 to 0.030 in. The ram slide, with automatic indexing and locking hexagon turret, has six power feeds from 0.003 to 0.030 in. Adjustable stops are supplied for each turret face.

The Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

Circle 365

Expanding Collet

Push type expanding collet for turret lathes is for internal chucking of ¾ to 6-inch diameters. The 4140 heat-treated steel master collet is made in types 1



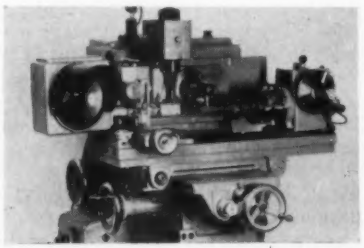
through 5, W & S. Soft expanding mandrels are in 1, 1½, 2 and 2½-inch diameters, 1½ or 2 inches long. These are machined to size or shape on the turret lathe on which they are installed, thus assuring concentricity.

Dunham Tool Co., Inc., Danbury, Conn. **Circle 366**

Punch Shaper

Machining tapered punches or forms within a range of ±3 degrees, contours of all kinds, and surfaces and punches with curved necks to a tolerance of ±0.00025 in. in one setting are among the capabilities of the K-15 form and punch shaper. A viewer with 20:1 magnification is mounted on the machine for control of the operation.

Speeds are 50, 75 and 110 strokes per minute; working area is 6 by 6¼ in; stroke is zero to 6 in. for punch shaping; maximum length to beginning of radius is 5¼ in. This shaper is equipped

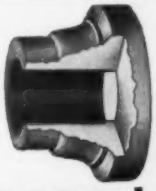


with a large dividing head with automatic circular feed and a coordinate chuck that permits machining radii, angles and tapers automatically.

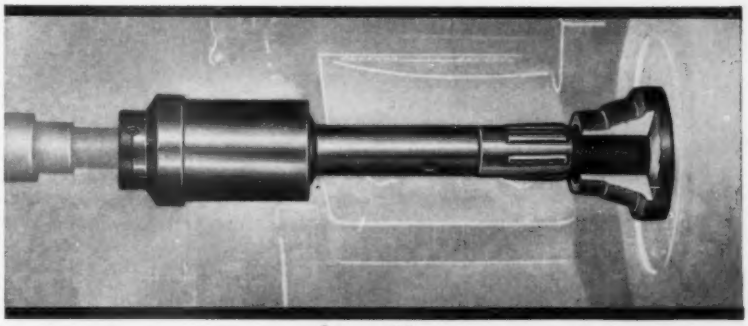
Jersey Mfg. Co., Livingston St., Elizabeth, N. J. **Circle 367**

Torque Tool

When preset torque has been reached, the Micro-Set torque tool clicks, eliminating glancing at dials and scales. After release, it automatically sets itself. Torque can be measured in both left and right-hand directions without adapters. Because of its compactness,

a 5 micro-inch  *surface finish*

in one 5-second pass!



a revolutionary **microller** *burnishing tool*

- Finishes roughest turned surfaces (ie: 200 mu.-in. and higher) to 4 mu.-in. and lower . . . *in one pass* at feed rates of 8 to 12 in. per minute. A one inch length in 5 seconds!
- Finishes all machineable metals . . . all types of surfaces; internal and external cylindrical; tapered, radial, flat.
- Use tool in any machine . . . any standard drill press or lathe, any screw machine or automatic. No special equipment needed.

ADJUSTABLE FOR SIZE CONTROL

- Sizes in increments of .000025" or less. Performs sizing jobs never before possible, ideal for bearing seats, oilite bushings, parts out of tolerance, etc.
- Run thousands of parts without tool wear, size setting, or adjusting. Highly hardened replaceable rolls and tip last through thousands of parts! No stones to replace.
- Standard tools and replacement parts available from stock.
- Microller burnished surface is a new concept . . . surface is *rolled* out, metal is condensed and hardened for longer wear. No grinding or honing grooves to wear away in service.

More than a thousand companies . . . including the top twenty in metalworking . . . have replaced costly finishing and sizing methods with Microller burnishing. Reports of 90% savings in production costs are common!

RESULTS GUARANTEED:

Sales and service representatives in all principal cities. Write for further information to

MADISON-FAESSLER TOOL CO.

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the tool is suited for close-quarter tightening in electrical and instrumentation work, aircraft, production testing, concealed areas and automatic transmissions. It can be provided with a ratcheting head.

Three sizes are available: MC150 for torque from 5 to 150 in-lb (¼-in. drive); MC750 for torque from 100 to 750 in-lb (⅜-in. drive); and MC1600 for torque from 700 to 1600 in-lb (½-in. drive). Over-all length is 5⅛ in.

Apco Mossberg Co., 1006 Lamb St., Attleboro, Mass. **Circle 368**

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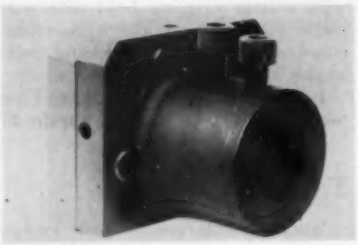
Turret Lathe Toolholders

Completely adjustable flanged toolholders for turret lathes are designed for mounting directly on the turret faces. Once adjusted to the centerline of the spindle they can be left in place on the turret. The need for troublesome floating toolholders is eliminated on older machines.

The toolholder consists of two parts: the base, which is centered on the face



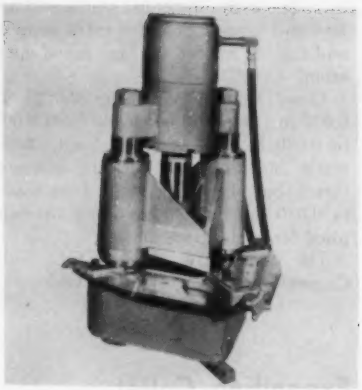
of the turret by a short pilot and bolted to the turret; and the adjustable member, which is aligned with the spindle by four small screws and then locked to the base.

These toolholders can be used with or without bushings for tools such as drills, reamers and boring bars. They are equivalent to the Warner & Swasey "short-length" toolholders in length.

Gahr Machine Co., 19199 St. Clair Ave., Cleveland 19, Ohio. **Circle 369**

Notching, Bending Press

Notching and bending operations can both be performed on the Model 610 press, eliminating the need for second-operation presses. Work is notched at one side of the press and then is moved

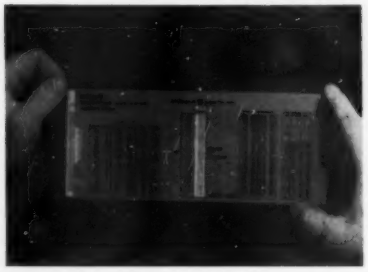


to the other side, where a single stroke of the ram bends the work 90 degrees. With a 1½-hp motor, speed is seven strokes per minute; with 3-hp speed is 12 strokes per minute. The press can notch and bend 4 by 4 by ¼-in. angle iron and will cope 5½ by 5½ by ¼-in. areas in corners of flat sheet or angle iron. Floor space requirements are 20½ by 21 in. and over-all height is 31 in.

W. A. Whitney Mfg. Co., 636 Race St., Rockford, Ill. **Circle 370**

Shrinkage, Draft Calculator

Pocket-size plastic slide-chart type calculator provides a time-saving method of determining shrinkage and draft



values. It also includes charts of tap drill sizes, decimal tables and other frequently used data.

Kelm Mfg. Co., Coloma, Mich. **Circle 371**

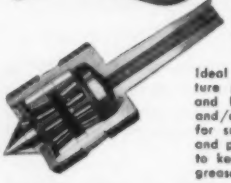
Drill Collet Chuck

Lower fixture costs, longer drill life and faster tool changes are made possible in single or multiple-spindle drilling machines by the "Stub-A-Long" drill collet chuck. The collets grip the drill on the shank or margins for locating and driving.

A back-up adjusting screw controls depth setting. The chucks fit any spindle that accommodates an adjustable adapter from ⅞ to 1⅞-in. shank size. Models

IDEAL GOLD BAND
LIVE CENTERS
GUARANTEED TO MATCH OR EXCEED, "CRITICAL" JOB SPECIFICATIONS

In the GOLD BAND line Ideal has combined the latest production methods with their traditionally fine craftsmanship to bring you an unequalled standard of excellence in live centers. Accurate, (to ± .0001") GOLD BAND Live Centers offer "custom" quality at production prices. Specify GOLD BAND Live Centers and your every need can be accommodated from stock . . . 99 times out of 100. Ideal's GOLD BAND Live Centers offer savings, simplified operations and higher lathe output both in quantity and quality. Contact your distributor today...or



PRECISION FITTED BEARINGS

Ideal Live Centers feature precision machined and hardened ball and/or roller bearings for superior accuracy and performance. Sealed to keep dirt out, grease in.

A COMPLETE LINE FOR EVERY NEED...SPECIALS, TOO!

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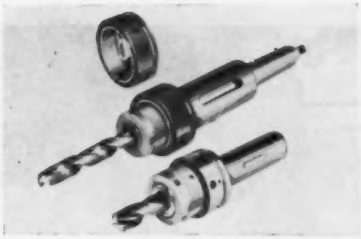


available use single-purpose collets for drills from ⅛ to 1¼ in. The chuck locks in the spindle nose with a setscrew and is driven by a woodruff key. Shank diameters and tolerances conform to automotive and ASA standards.

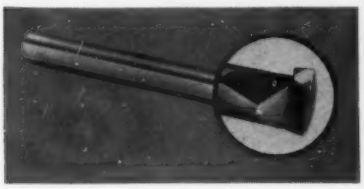
A "Quick-Ball-Lock" collar, which mounts to the face of the spindle, permits quick removal of the chucks when used in multiple-spindle machines on which fast, programmed tool changes are desirable.

Scully-Jones and Co., 1901 South Rockwell St., Chicago 8, Ill.

Circle 372

Carbide Boring Bar

Features of a carbide boring bar for use on jig borers and lathes are an extra-wide solid carbide butt brazed to the shank; lapped finish; radial relief; tough steel shank. Regrinding of the



Bor-Bar is accomplished with a V-block and diamond wheel; no special fixtures are required. Minimum hole diameters are ⅜ to 1 inch; shank diameters are ¼ to ¾ inch; over-all lengths are 2 to 6 inches.

Jarvis Corp., Middletown, Conn.

Circle 373

Work Positioner

Heavy, odd-shaped work is positioned for welding or fabrication with the PM-1051 positioner, which will handle weldments weighing as much as 2000 lb. The 32-inch table has six T-slots for jigs or fixtures. It tilts from "work vertical" position to "work 15 deg below the horizontal." A desired tilt angle is set on the protractor and the tilt button on the operator's control panel is momentarily depressed. The table stops automatical-

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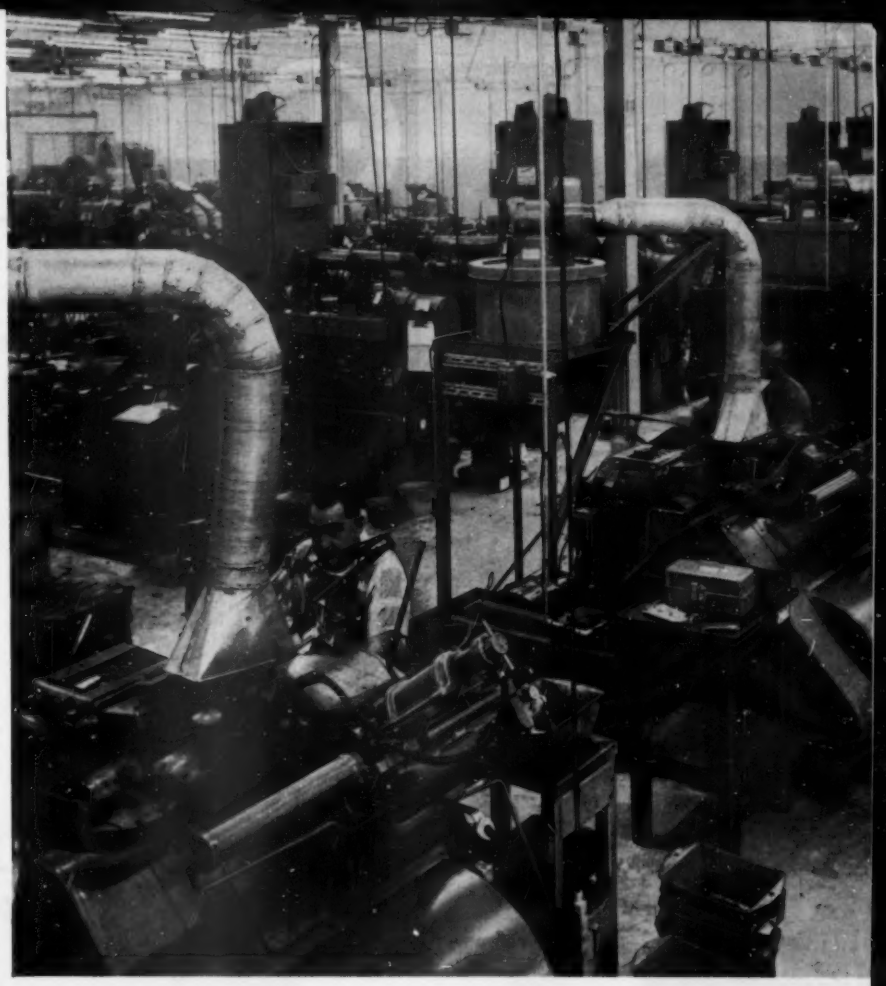


NEW

This is the ~~old~~ grind at

ALLEN

A quarter of a million square feet of space in the great new Allen plant is devoted to precision fasteners – and much of it houses batteries of the latest, high-speed automatic centerless grinding equipment. Here you see a close-up of the grinding section set up to produce dowel pins at the rate of one a second per machine.

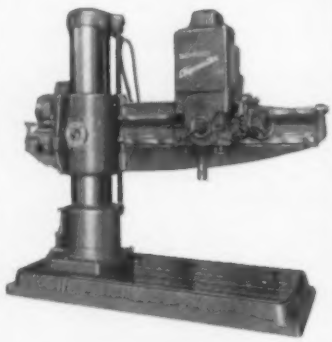
Allen's vast new facilities assure constant standards of uniformity, accuracy, strength and fit, many of which are duplicated nowhere else. Now there's more reason than ever to make Allen *your* Buy-Word for socket screws, keys, pipe plugs and dowel pins.

Speaking of dowel pins – specify *Allen* for great strength where you need it most. Made of Allenoy steel, they're surface hardened to 62-64 Rockwell C. Core hardness 47-53. Case depth .010" to .020". Shear strength from 160,000 to 180,000 psi. Precision-ground to ±.0001", with a mirror finish of 6 RMS max.

In stock at your Allen Distributor . . . in dias. from ⅛" thru 1" . . . lengths from ⅜" thru 6". Also in two standard oversizes – .0002" for press fit, .001" for repairs. For more details, ask your local Distributor, or write directly to the Allen Manufacturing Company, Hartford 1, Conn.

ALLEN HEX-SOCKET SCREWS HEAD

Class 3 threads guaranteed...



ALL-NEW CHIPMASTER®

the heavy-duty radial that does more than any before.

If your radial drilling machines are limited to simple drilling and hole-enlarging jobs, consider what the new Cincinnati Bickford Chipmaster offers you.

Machining of the electric motor end bell housing illustrated is a good example of what you can accomplish with a Chipmaster. On a lathe it took 30 minutes to machine each hole; on a Chipmaster 1½ minutes, or 1/20 the previous time. 5″ diameter boring is completed in 27 seconds with a .083″ feed at 35 rpm. Facing is done in 25 seconds with .020″ feed at 16 rpm. Class 3 fit thread tapping is done in 40 seconds with a 5″—12-thread tap driven at 30 rpm and retracted at 75 rpm.

With Chipmaster rigidity and thrust capacity you can handle everything from light drilling and tapping to the heaviest boring, facing, spade drilling, and trepanning operations. You can do work now being done on slower or more costly machines. You can use optimum feeds and speeds for maximum production. You can take advantage of carbide tooling.

There's a Chipmaster to meet your requirements: 13″-15″-17″-19″ column diameters. Three head styles available: mechanical shift, partial preselect (36 speeds), full preselect (36 speeds and 18 feeds). Ask for Catalog R-35 for complete details.

GIDDINGS & LEWIS MACHINE TOOL COMPANY

CINCINNATI BICKFORD DIVISION, Cincinnati, Ohio

Giddings & Lewis also manufactures: vertical and horizontal boring machines, vertical turret lathes, planers, planer mills, contour milling machines, die sinking machines, drilling machines, numerical and tracer control systems, boring tools and related items, and machine tool accessories.

Things to look for in a radial drill

When you compare radial drilling machines, consider the Chipmaster design factors that will give you optimum production and enable you to handle a wider range of work.

Rigidity. Chipmaster column is up to 17⅛" shorter than other radials. Column sleeve is supported by preloaded bearings. Massive close-coupled construction provides maximum resistance to deflection, lets you apply heavier feeds for more work per hour.

Spindle Construction. You can't apply too much thrust to a Chipmaster spindle. It rides on a quadruple bank of precision preloaded bearings. It never feeds away from its support—spindle, sleeve, and bearings feed down together. Both spindle and sleeve are high alloy chrome nickel steel. The sleeve is supported in a honed head bore 17½" long. You get positive accuracy for tapping and maximum rigidity for heavy feeds and accurate single-point boring.

Herringbone Drive Gear. No other radial offers you this feature for smooth transmission of full machine power to the spindle under heavy feeds and slow speeds. Gear is declutched for high-speed operation to eliminate flywheel effect.

Before you buy a radial, watch the Chipmaster work. Call your Cincinnati Bickford distributor or write today for Catalog R-35.

The chip that proves the difference...

. . . made at .100" feed, 45 rpm, with a 3" twist drill driven in solid steel by the all-new Chipmaster radial. Ask your Cincinnati Bickford distributor to show you one of these chips.

the symbol for machining cost reduction

CB-112

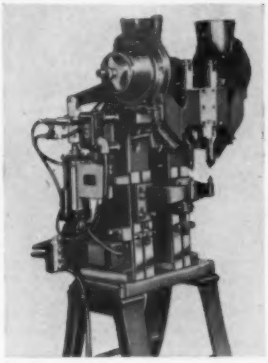
USE READER SERVICE CARD, CIRCLE 39

ly when the work reaches the correct position. Rotation speed of the table, which turns through 360 deg in either direction, can be varied continuously from zero to four rpm.

Boesch Mfg. Co. Inc., Danbury, Conn. **Circle 374**

Automatic Rivet Setter

Pneumatic setters can successfully fasten materials such as ceramics and plastics with minimum breakage. Cushioned operation makes the machines suitable for fastening assemblies with uneven material thicknesses.



The Model 180 double rivet setter (illustrated) has a throat depth of six inches and will set up two 0.098-in. steel tubular rivets or two ⅛-in. brass tubular or split rivets at the same time. Maximum rivet length that can be set is 7/16 in. Centers are adjustable from ⅜ to 6 inches.

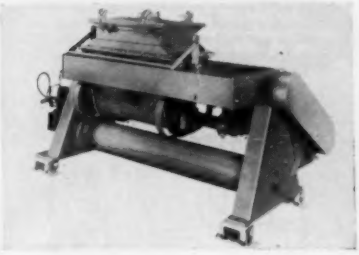
Quick-change hoppers with integral raceways permit setting of other rivets having smaller body diameters and within the minimum rivet length. Change-over for different rivets takes only a few minutes, and involves replacement of hopper, driver jaws and anvil.

Chicago Rivet & Machine Co., 950 S. 25th Ave., Bellwood, Ill. **Circle 375**

USE READER SERVICE CARD ON PAGE 145 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Rotary Vibrator

Metal, wooden or plastic parts can be cleaned, descaled, deburred, fine finished, colored and burnished, and radii can be generated, in the 15-hp Lorco Vibrator. Media, compound and water are used as in conventional barrel finishing. The load of parts and media rotates as a mass and an additional scrubbing action between the load constituents is induced through controlled vibration. Both the amplitude and the frequency of the vibration can be controlled, allowing the Vibrator to do



everything from coarse work, requiring severe cut-down, to delicate precision jobs. Interior finishes and finishes in shielded areas can be obtained.

The rubber-lined bowl, which has a capacity of 6.92 cu ft, is mounted on coil and leaf springs and vibrated by an eccentric shaft. Drive speed is continuously variable over a range from zero to 2100 rpm.

Lord Chemical Corp., 2068 South Queen St., York, Pa. **Circle 376**

Tool Radius Checker

Radius of cutting tool edges is critical in hemisphere turning and when employing numerically controlled machine tools for highly accurate contouring. Precise measurement of tool nose radii

is achieved on the Monarch radius checking instrument.

Using the instrument, the nose radius of a tool is compared against the known radius of a precision ball. If the tool radius dimension differs from that of the standard ball, a micrometer head is

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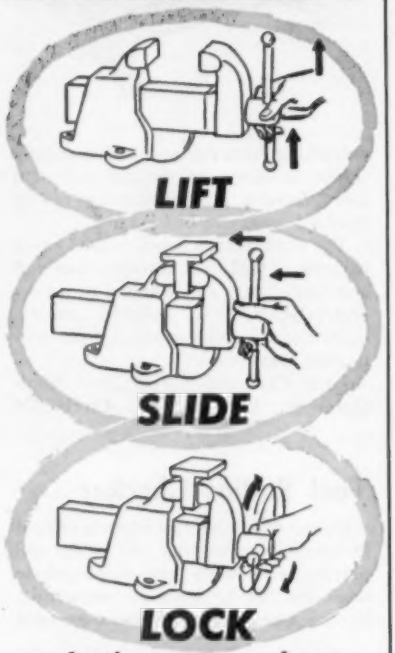
model CARDINAL
SPEED-VISE
SLIDES!



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production capacity goes up!

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SIZES, 3½", 4", 4½" stationary or swivel base.

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FAST - SIMPLE
POSITIVE

Patented undercut thread of screw and nut assure positive locking.

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CARDINAL MACHINE CO.

1819 DANA ST., GLENDALE, CALIF.

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adjusted to determine the amount of error. Deviations are read on an electronic indicating device. Location of these deviations can be recorded with respect to the angular position of the instrument's measuring head.

The Monarch Machine Tool Co., Sidney, Ohio. **Circle 377**

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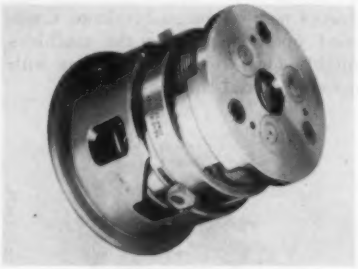
Thread Rolling Head

Of "pull-off" design, the No. 7TRP revolving type thread rolling head has a 7/16 to 7/8-in. U.N.F. and U.N.C. range. It is intended for application to Landis automatic forming and threading machines and four-spindle semiautomatic threading machines. The head is automatically opened by interrupting the



forward travel of the machine's threading spindle. For closing, a cam shoe actuates the head's operating ring as the machine spindle is withdrawn after rolling.

Helix angle bushings are replaceable. One set of bushings functions as a "mean" helix angle for all pitches and diameters within the range of the machine. For precision threads, bushings with exact helix angles are supplied, eliminating the need for purchasing a special head to obtain precision threads.

Landis Machine Co., Church and Fifth Sts., Waynesboro, Pa. **Circle 378**

Bottoming Bar

Walls and bottoms of holes can be finished to close tolerances with this bar. Cutters have an adjustment allowing up to 0.300-inch expansion. Exact bore diameters are attained by "milking" across the cutters. The bar is not designed for full bottoming since, in expanded position, a small gap exists between the two cutters. It will, however, square off internal shoulders, cleaing up bottoms to within a small distance of hole center.

A floating mount permits lateral movement of the cutters, thus equalizing chip load. Cutters are held in the bar slot by a cam-lock. Standard size range is 1 to 5 in., ID. M-3 high-speed steel cutters are standard: tungsten carbide cutters are available.

Robert H. Clark Co., 9330 Santa Monica Blvd., Beverly Hills, Calif. **Circle 379**

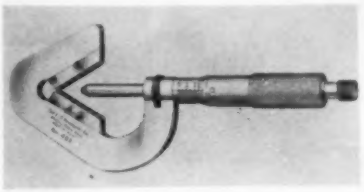
Round Inserts

Ceramic throwaway inserts are now available in the round form. VR-97 ceramic, the tool material, has extreme resistance to heat, edge wear and cratering. Speeds up to 2000 fpm with up to 3/8-in. dept of cut and feeds from 0.005 to 0.020 ipr are possible, depending on the operation performed.

Vascoloy-Ramet Corp., Waukegan, Ill. **Circle 380**

V-Anvil Micrometer

Conventional two-point measuring tools, which check diameter only, will pass out-of-round work. No. 483 V-Anvil micrometer has three-point contact for

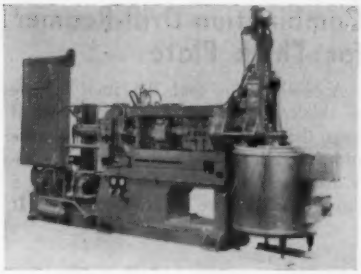


checking out-of-roundness. It can also be used for measuring three-fluted cutting tools. Readings are taken directly in thousandths of an inch from the micrometer thimble.

The L. S. Starrett Co., Athol, Mass. **Circle 381**

Diecasting Machine

Small-size zinc die castings can be produced automatically at high speeds in the Lester HP-½Z-SF machine, which will cast up to 6¾ lb of zinc at over 1000 free cycles per hour. It is equipped with a 25-hp motor and 2750 cu in accumulator. Dies up to 16 in. high and requiring a 9-in. opening can

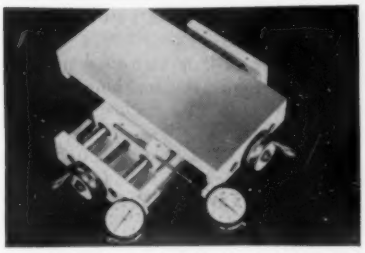


be accommodated. Standard features include central screw die height adjustment up to three in., automatic cycling, low-pressure die closing circuit, air-operated die clearing assembly and SDCE ejector bar pattern.

Lester-Phoenix, Inc., Dept. N-31, 2711 Church Ave., Cleveland 13, Ohio. **Circle 382**

Two-Way Compound

Inaccuracies in slide tolerance and backlash in screws and nuts found in conventional dovetail slides have been overcome with a two-way adjusting compound for precision locating and hold-



ing of workpieces. Dial indicators and adjusting rods, mounted on the compound, compensate for backlash and allow adjustments to tolerances of 0.0001 in. The slide, which can be adjusted up to four inches, is mounted on ball bushings and has a cast-steel base.

Tracer Control Co., 595 E. Ten Mile Rd., Hazel Park, Mich. **Circle 383**

Grinding Wheel Balancer

Line of portable balances has been designed for internal, external, centerless and center grinding machines. Precision balance is achieved and the machine is returned to production in less than 30 minutes. Once the hub and wheel are in position, balancing is accomplished by use of three adjustable weights inserted in the hub. Two balance screws permit micrometer adjust-

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Heavy duty 2500-Ton Hydraulic Cold Forging Press

150-Ton Hydraulic Hot Plate Molding Presses

Oliver-Farquhar builds hydraulic presses in a wide range of types and capacities to give you what you want!

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Hydraulic and Mechanical Press Department
York 96, Pennsylvania

OLIVER Farquhar PRESSES

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ment of the weight. Vibration tests show repeated accuracy within 0.000040-inch displacement (concentricity).

Aero Supply Mfg. Co., Corry, Pa.
Circle 384

Wheel Dresser

Intended for diamond and other wheels, the Spin-Kontrol dresser features a free-spinning wheel which has a crushing effect that removes bonding

material and exposes the diamonds without tearing them from the wheel. This can result in substantial savings in diamond wheel replacement costs. Flying chips are held to a minimum. The tool is furnished with three wheels: one for diamond wheels, one for coarse-grit wheels, one for fine-grit wheels.

Jarvis Corp., Middleton, Conn.
Circle 385

Tracer Tools

All component parts, except the holder shanks of the Multicut insert holders for tracer turning are standardized and interchangeable. One

anvil-locator, one clamp, one locking screw, one taper-head screw and one diamond-shaped insert will fit all four holders. The tools also can be used for recessing, outfacing, undercutting and plunge turning.

Standardization of the four holders—Styles DAR-C, DAL-C, DTRL-C (illustrated) and ZX-8-T5C—involved standardization of the 55-deg diamond-shaped carbide insert used in all of them. The anvil-locator and the insert are precision ground so that 3/16 in. flats on both sides of the insert are held snugly in the anvil-locator so that proper rigidity is retained during tracer turning. Side-cutting loads will not cause chatter or displacement of the insert.

Standardized tungsten-carbide tipped clamps for chip control, and square-headed locking screws for greater clamping pressures are available for use with these holders.

Wesson Co., 1220 Woodward Heights Blvd., Ferndale 20, Mich. **Circle 386**

USE READER SERVICE CARD ON PAGE 145 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Tapping Attachment

Tapmatic 300A tapping attachment is capable of continuous operation at speeds up to 2500 rpm. Designed to avoid usual tapping hazards, this tool has an axial floating drive spindle and a supersensitive spring loaded ball clutch. There are no friction clutches,

planetary gears or lead screws. A relatively unskilled operator can produce consistently precise threads without danger of tap breakage.

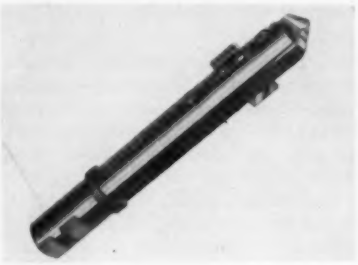
Necessary driving torque is quickly and simply adjusted prior to actual tapping and cannot be changed by the operator during the operation. Reversing torque is automatically increased or decreased when driving torque adjustments are made. The tap stops as soon as it becomes dull, loaded or bottomed in blind hole tapping.

Designed to meet the need in industry for a rugged, compact, precision tapping, the 300A has a diameter of $1\frac{27}{32}$ in. and a length of $3\frac{3}{4}$ in.

Tapmatic Corp., 845 W. 16th St., Costa Mesa, Calif. **Circle 387**

Combination Drill-Reamer for Thick Plate

A combination tool, designed for use on thick plate for rapid production of large diameter holes to close tolerances and with excellent finish, simultaneously drills and finishes holes to size with a single quill stroke of the machine. It



consists of a bar which combines a replaceable spade drill with an adjustable cutter for reaming the hole to size. The adjustable cutter is a floating finishing type in which the blades expand and lock to desired dimension. They are mounted in the bar with a cam-lock design which permits a lateral float to the cutter. As a result the cutter centers itself to the hole.

The spade drill is furnished in M-3 high-speed steel; the finishing cutters are available in M-3 high-speed steel or carbide tipped.

Robert H. Clark Co., 9330 Santa Monica Blvd., Beverly Hills, Calif.
Circle 388

Air Impact Tool

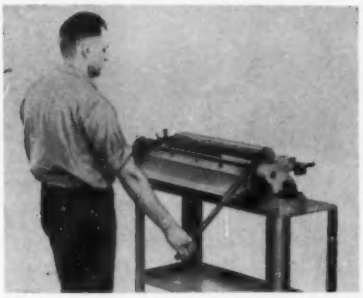
Delivering 1200 impacts per minute, the Size 804 Impactool weighs $5\frac{7}{8}$ lb, is $6\frac{3}{8}$ in. long and has a $1\frac{3}{8}$-in. side-to-center distance. A standard square driver measures $\frac{1}{2}$ in. across flats; an optional driver measures $\frac{5}{8}$ inch across flats. Although shorter and lighter than previous models, this tool delivers 40 percent more power and 100 percent faster run-down. Capacity is $\frac{3}{8}$ inch.

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y. **Circle 389**

Box Finger Brake

Four-in-one machine performs as a box and pan brake; as a bar folder or standard folding brake; as a radius former and as an open-end former. It is designed for use in experimental labs, model shops and plants with short-run production.

Undercut box fingers of this Di-Acro Model 24 machine enable material as thick as 16-ga mild sheet steel to be

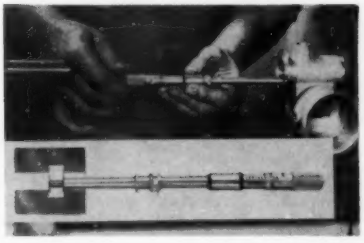


formed into boxes and chassis as deep as three inches and with up to ½-inch lips. Maximum bending angle in one operation is 135 deg. Forming width is 24 in. The machine is equipped with a micrometer back gage.

O'Neil-Irwin Mfg. Co., 625 Eighth Ave., Lake City, Minn. **Circle 390**

Internal Micrometer

Multi-Mike internal micrometer measures cylinder groove and land widths; O-ring widths; groove and keyway locations. Measurements accurate to 0.0005 inch are possible from 0.050 to 1.050



inch for groove widths; from zero to 1.000 inch for lands and distances between grooves. This model will locate from an external reference point to its probe depth of 5¾ inch.

Navan Products, Inc., 900 N. Sepulveda, El Segundo, Calif. **Circle 391**

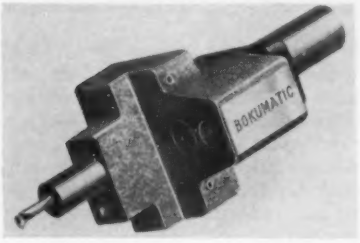
Free-Machining Steel Tubing

Leaded C-1020 carbon steel tubing is characterized by outstanding machining properties. Addition of 0.15 to 0.35 percent lead increases machineability from 72 to 85-90 percent, making possible increases in cutting speed from 120 to 140-150 fpm. There is virtually no difference in physical and mechanical properties between leaded and non-leaded C-1020. The tubing is seamless and is furnished in sizes from 0.012 to 1⅛ in. OD.

Superior Tube Co., 1732 Germantown Ave., Norristown, Pa. **Circle 392**

Holders for Internal Tools

Operations requiring internal grooving, back chamfering, thread recessing or special internal forming are expedited by the Bokumatic RT series of toolholders. Actuation is by means of a stop rod against the spindle or spindle guard, or with a draw bar. During

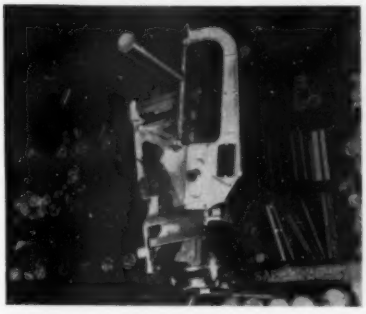


operation, movement consists of a horizontal, straight-line entry with a dovetail side action during cutting of as much as 0.072 in. per side in the smallest holder to 0.350 in. in the largest holder. Actual metal removal starts as much as two seconds sooner than in conventional holders.

Bokum Tool Co., 14755 Wildemer Ave., Detroit 38, Mich. **Circle 393**

Power Hack Saw

Forty-eight lb portable saw has a high-speed blade that cuts anything from 3 by 3-in. solid steel to thin-wall

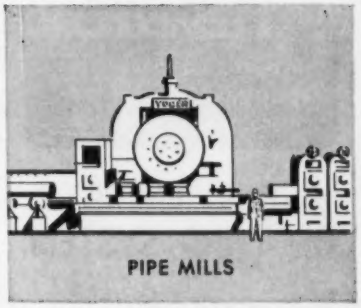


tubing with a tolerance of 0.005 in. It can be used in any position—even upside down. The Hand-I-Hack saw can be used with an attaching vise calibrated for cutting angles up to 45 deg.

Lipe-Rollway Corp., Syracuse, N. Y. **Circle 395**

Air Gage Recorder

Data gathering for dimensional quality-control charts or a charted record to serve as a size certificate can be made



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PIPE AND TUBE MILLS

Today's expanding markets and tightening economy demand closer production cost control. YODER'S complete line of ferrous or non-ferrous Pipe and Tube mills can help you meet production schedules economically... help you realize significant savings in the manufacture of tube and pipe.

YODER Pipe and Tube mills offer flexible production to meet fluctuating demand. They adapt easily to the most rigorous schedules. Everyday manufacture of constant high quality pipe and tube in diameter of 5/16" to 24". Speeds up to 350 fpm plus can be obtained with YODER mills.

YODER also makes a complete line of Slitting equipment and Cold Roll-Forming machinery. Send for your copy of the fully-descriptive book covering Tube Mill operation.

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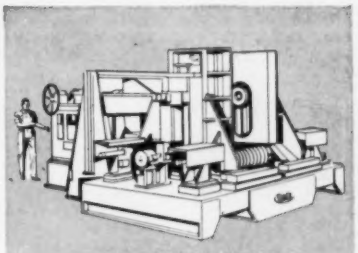
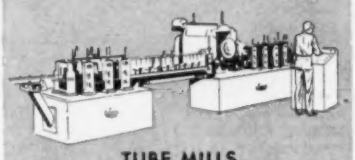

HEAVY DUTY UNCOILERS


TUBE MILLS

ENGINEERING YODER MANUFACTURING
PIPE AND TUBE MILLS
(ferrous or non-ferrous)

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IN EVERY FIELD, THERE IS ONE FOREMOST NAME . . . IN SONIC ENERGY, THAT NAME IS BENDIX

SONIC ENERGY CLEANING SYSTEM

Pays for itself in 6 months!

If you've heard people say that the results of Sonic Energy Cleaning can be spectacular, here's an example of what they mean:

A nationally known aircraft parts manufacturer had to remove dirt, grease, sludge, metal chips and abrasives from assembly components of a 4-stage aircraft compressor. Optimum cleanliness was vital. Previous methods were costly and unreliable.

Using the Bendix Sonic Energy Cleaning System with an inexpensive, nonflammable, nontoxic detergent solution, in a one-minute cleaning cycle—all traces of contamination—including both soluble and insoluble soils—were removed, even from blind holes, interstices, crevices, screw-threads, porous surfaces.

And the best part—direct labor costs were reduced 50%; expensive solvents were eliminated; rejects due to contamination were eliminated; and the complete Bendix Sonic Energy Cleaning System was fully amortized in six months.

To help you determine if results like these are possible in your cleaning operation (and sometimes they're not), Bendix® maintains a complete Applications Laboratory to go with the industry's most complete line of Sonic Energy Cleaning equipment.

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SONIC ENERGY CLEANING

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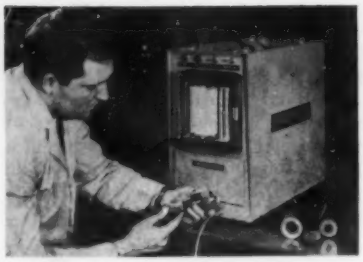


to machine accuracy with the Air Gage Recorder. The instrument, which uses hand or fixture type air gage tooling, makes an automatic record showing a part's plus or minus deviation from nominal size on a four-in. wide strip chart during gaging. Back pressure type air gage tooling is used for size-sensing elements.

The Sheffield Corp., Dayton 1, Ohio. **Circle 396**

Paint Spray

Use of compressed air is discarded in the Chemtronic paint spraying system.

Instead, a hydrocarbon compound is utilized for transportation of paint materials. The compound is atomized by an electronic heating element within the spraying unit. No mechanical parts are involved in atomization, so operation is noiseless.

The heating permits a higher concentration of solids and allows more paint to be sprayed without sagging. Finishes applied in one operation are equivalent in thickness and surface to two or three coats applied by other spraying processes.

The Lofstrand Co., Southlawn Lane, Rockville, Md. **Circle 397**

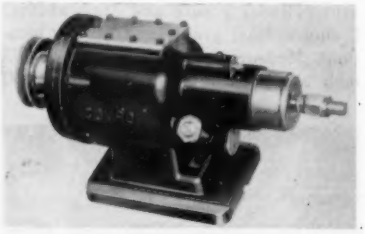
Turret Lathe Toolholder

Intended for close-tolerance finishing operations such as counterboring, step reaming, tapping and chasing, the "Tru-Align" turret lathe toolholder corrects for both radial and angular misalignment between the spindle center line and the center line of the turret. This enables the tool to feed into the work in perfect alignment with the spindle. Once true center alignment is established, no further adjustment is required.

Sonnet Tool and Mfg. Co., 576 N. Prairie Ave., Hawthorne, Calif. **Circle 398**

Automatic Drilling Unit

Equipped with an infinitely variable hydraulic feed control, adjustable rapid approach to control the tool at entry and at break-through, the Model KHB drilling unit does not require shop air.



It rotates and feeds the tool into the work when the motor is turned on; withdraws when the motor is turned off. For use, the unit is mounted on a plate and driven by an electric motor through a belt drive. Accurate depth is held, since the unit dwells against a positive stop at end of stroke.

Govro-Nelson Co., 1931 Antoinette Ave., Detroit 8, Mich. **Circle 399**

Safety Hydraulic Fluid

Water-in-oil emulsion type hydraulic fluid called "Sunsafe" has a high viscosity index (130) and excellent film strength at high temperatures.

This fluid can be used in any hydraulic system at pressures up to 2000 psi and operating temperatures to 150 F.

The fluid is formulated from a base oil compounded to form a stable emulsion. Water-to-oil ratio is 40:60.

Even in the event of a break or rupture in the hydraulic system in the presence of flame or incandescent particles, the fluid will not flash or support combustion.

Sun Oil Co., Industrial Products Dept., 1608 Walnut St., Philadelphia 3, Pa. **Circle 400**

Through each and every stage in the manufacture of a Pipe Machinery gage, our operators feel a very real —a very personal responsibility for the quality of the product they are helping to produce.

Supporting this meticulous operator control of quality is individual operator inspection equipment and our own air conditioned inspection laboratory. Here gages are subjected to further rigorous examination by alert and vigilant technicians employing a battery of modern instruments such as the length measuring machine shown below (used to check internal and external diameters).

For further information, send for our #11 catalog, or better yet, stop in and visit us next time you're in the area. We'd be proud to show you personally how rigid inspection methods help make Pipe Machinery gages outstanding.

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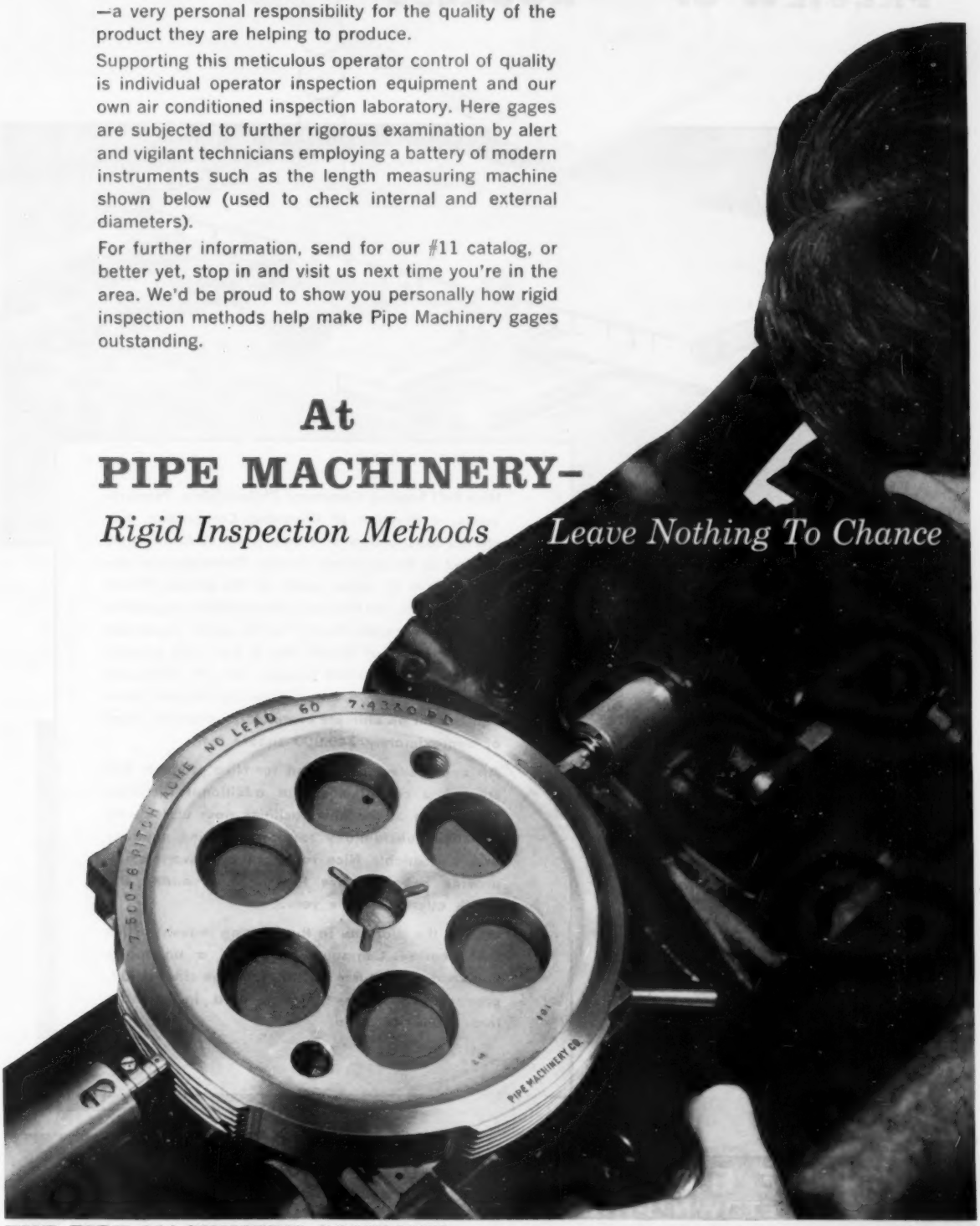
Rigid Inspection Methods Leave Nothing To Chance



THE PIPE MACHINERY COMPANY • 29100 Lakeland Boulevard • Wickliffe, Ohio • Greater Cleveland

PREVIEW OF PROGRESS

NICE BALL BEARING COMPANY
Division of Channing Corporation
Towamencin Township, Montgomery County, Pa.

NICE PLANS LONG RANGE PLANT EXPANSION

First Unit to be Completed in 1959

Nice Ball Bearing Company, Philadelphia, Pennsylvania, a Division of Channing Corporation, has started construction of a new plant addition to be located in Montgomery County, Pennsylvania, approximately 30 miles north of the present Philadelphia plant. The first unit, scheduled for completion in 1959, represents Nice's fourth major expansion since the end of World War II and will provide approximately 40,000 square feet of additional manufacturing area. Future plans for the new location call for an ultimate completely integrated plant of approximately 340,000 square feet.

An unprecedented demand for Nice products has created a critical need for additional facilities. Completion of the new facilities now under way will add substantially to manufacturing capacity and will enable Nice to improve deliveries and provide better service to customers during the fourth quarter of this year.

One of the pioneers in the bearing industry, Nice Ball Bearing Company has been a nationally known manufacturer of ball bearings since 1902, producing bearings that are used in products throughout the world.

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NICE BALL BEARING COMPANY
NICETOWN · PHILADELPHIA · PENNSYLVANIA
DIVISION OF CHANNING CORPORATION

Trade Literature

for free booklets and catalogs—use request card, page 145

Roller Bearings

A 48-page Engineering Reference Manual M-59 gives construction, dimensions, capacities, housing and tolerance fits for the complete line of Orange Roller Bearings. Included are staggered roller bearings, full type needle bearings, cage type needle bearings, journal roller bearings, cam followers, cam yoke rollers and thrust roller bearings. Orange Roller Bearing Co., 557 Main St., Orange, N. J. **Circle 301**

Threading Heads

Bulletin F-90-4 includes detailed information and specifications on the recently announced JN Landex die head suitable for application to automatic screw machines, chucking machines or other machines incorporating a revolving threading head and the De Landmatic specifically designed for application to Brown & Sharpe automatics. Landis Machine Co., Waynesboro, Pa. **Circle 302**

Numerical Positioning Control

General Electric's complete line of standard, pre-engineered point-to-point numerical positioning control "packages" for use on any machine requiring point-to-point positioning of linear or rotary-motion members is described in detail in Bulletin GEC-1531. Specifications, performance, and auxiliary functions are described, and dimensions and internal structure are illustrated by drawings and photographs for controls from the Mark I through the Mark V. Information is also included in the Mark I-M a semiautomatic system for one motion control from manually set decades. General Electric Co., Schenectady 5, N. Y. **Circle 303**

Computer Uses

Paper by Paul Seligmann, senior research physicist at the Research & Development Laboratories of the Portland Cement Association describes the problems that led to the acquisition of a small digital computer; the uses to which the laboratory has put the machine and the benefits derived. Available as S-509 from the Royal McBee Corp., Port Chester, N. Y. **Circle 304**

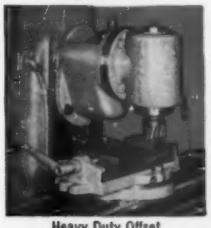
Switches

Revised Catalog 90b describes standard line of mercury switches; includes dimensions, electrical ratings, application information and complete technical data illustrated by photos. Micro Switch. Freeport, Ill. **Circle 305**

Fluid Power

Fluid Power News No. 9, four pages illustrates and describes how Oilgear application-engineers solved linear and rotary drive problems. Available from The Oilgear Co., 1571E W. Pierce St., Milwaukee 4, Wis. **Circle 306**

Heavy Duty Vertical Milling Attachment



Heavy Duty Offset Vertical Milling Attachment

Universal Milling Attachment

Toolmakers Overarm

Heavy duty attachments increase versatility of dependable, low-cost

GREAVES MILLS

"THE MOST MILL FOR THE LEAST MONEY"

A full line of attachments and accessories offer outstanding flexibility for all types of milling operations . . . with GREAVES MILLS. Make your own comparison of 22 specifications of Greaves and 7 other leading milling machines.

Extra size table with 34" travel optional at extra cost.

Send coupon for FREE Comparison Chart and detailed descriptive literature on easy-to-use attachments.

GREAVES MACHINE TOOL CO.
2303 Eastern Avenue, Cincinnati 2, Ohio

Send Comparison Chart. I will make my own comparison of GREAVES MILLS with other makes.
Send information on Attachments and Accessories for GREAVES MILLS.

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FIRM _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

USE READER SERVICE CARD, CIRCLE 47

Gun Drills

Manual on gun drills includes information on machinery, feeds and speeds for gun drilling, starting bushings and alignment, coolant systems, point styles and resharpening. Well illustrated and informative manual has 16 pages. The Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio. **Circle 307**

Limit Switches

Booklet entitled "Suggestions for the Proper Application of Industrial Limit Switches," has been published by the National Electrical Manufacturers Association as authorized engineering information. Available from Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill. **Circle 308**

Machinery Replacement

Fourteen-page illustrated brochure gives details on how replacement of old machines paid off for six manufacturers. Booklet describes mathematically right time to replace a machine tool. Six machinery replacement analyses are covered. The Heald Machine Co., 10 New Bond St., Worcester, Mass. **Circle 309**

Punch Presses

Manufacturers of Rousselle punch presses have issued a new condensed catalog featuring twenty-two floor model presses and six bench models including the new Rousselle Econo-Air friction clutch and brake. Service Machine Co., 2310 W. 78th St., Chicago 20, Ill. **Circle 310**

This is a MARVEL High-Speed-Edge Hack Saw Blade Cutting a 4" x 4" Titanium Billet

EVERYTHING'S IMPROVED BUT THE GUARANTEE

33 years ago, MARVEL introduced the first welded-edge hack saw blades . . . guaranteed them to be shatterproof . . . and a new concept of power hack sawing came into existence.

In combining, by welding, two materials—a narrow, high speed steel cutting edge, and a tough alloy steel body, MARVEL pioneered the modern hack saw blade.

When operators learned they could apply the heaviest feed pressures and highest speeds to the new MARVEL Blades with complete confidence that they would never shatter or "explode" to cause them personal injury, hack sawing began the approach to its present high level of efficiency. Even cutting "exotic" metals, such as titanium, where heavier feed pressures are a necessity, the MARVEL Blade does an outstanding job and is completely safe.

Today's MARVEL High-Speed-Edge Hack Saw Blades are greatly improved, even over the MARVEL Blades which were the best on the market a few years ago. Advanced metallurgy has produced better steels; new heat treating and manufacturing techniques have brought further improvements. The only thing unchanged is the Guarantee: THEY ARE SHATTERPROOF!

If you haven't used MARVEL High-Speed-Edge Hack Saw Blades recently, try them on your saws for a month and see the difference a truly superior blade can mean in higher speeds, greater accuracy, lower cost per cut, and guaranteed safety to operating personnel. Your nearby MARVEL Distributor carries a complete stock of MARVEL High-Speed-Edge Blades.

Write for Bulletin CT-175 which has complete details on MARVEL High-Speed-Edge Hack Saw Blades.

ARMSTRONG-BLUM MFG. CO.
5700 W. BLOOMINGDALE AVE., CHICAGO 39, ILL.

MARVEL Metal Cutting SAWS

USE READER SERVICE CARD, CIRCLE 48

Tap and Gage Selector

A handy new Tap and Gage Selector Chart containing at-a-glance information formerly obtainable only from two or three different references lists the DoAll tap, tap drill size and plug and ring gages needed to produce and check classes of thread. It shows all standard N.C. and N.F. sizes as well as many N.E.F. and N. sizes considered special and not readily available elsewhere. The chart 22 x 28 in. is color coded in yellow, green, black and white for ease of locating the information desired. Available free from any local DoAll Sales-Service Store or by writing to The DoAll Co., Des Plaines, Ill. **Circle 311**

Atmosphere Heat Treating

Newsletter covers actual case histories and shows applications of heat treating in hydrogen and other protective atmospheres on such processes as cycle annealing, furnace brazing, stress relieving, solution heat treating, precipitation hardening, etc., on materials such as 347, 304 stainless steel, Vascojet, A-286, 17-4 and 17-7PH, Berylium, Inconel, etc. Also describes applications of simultaneously brazing and hardening of aircraft stainless parts and heat treatments of nuclear components. Ferrotherm Co., 1861 E. 65th St., Cleveland 3, Ohio. **Circle 312**

Hydraulic Packings

Sixteen pages of engineering data are contained in a new brochure on homogeneous and fabric reinforced hydraulic packings. The information encompasses design, construction, sizes, applications, installation, proper usage and service and temperature factors for V-rings, U-cups and piston cups. Text is accompanied by illustrations, engineering drawings and informative tables. Crane Packing Co., Dept. TE-3, 6400 Oakton St., Morton Grove, Ill. **Circle 313**

Encapsulation

"Improved Casting Techniques for Void-Free Encapsulation of Electrical Components in Epoxy Resin" is the title of a new technical bulletin offered by Automatic Process Control. The bulletin describes atmospheric casting, vacuum casting, and pressure stalling as the three principal methods of encapsulating coils, motor windings, transformers and other electrical components. Included with the bulletin are three trouble shooters check lists; problems encountered in evacuation systems; problems caused by improper mold design and problems arising from poorly selected resin systems. Automatic Process Control, 1170 Morris Ave., Union, N. J. **Circle 314**

Stainless Steel Wire

Comprehensive 77-page book on cold drawn stainless steel wire describes general qualities of 27 different types of ferritic, austenitic, ferritic-austenitic and martensitic stainless steels. Specific information on these steels in the cold drawn condition includes data on tolerances, mechanical properties, magnetic properties, available finishes, sizes forms and applications. Uddeholm Co. of America, 155 E. 44th St., New York 17, N. Y. **Circle 315**

Slitting Lines

Newly revised 6-page brochure titled "Slitting Lines for Coils and Sheets" contains basic information on design, selection and operation of slitters and slitting lines. It includes detailed time studies and analysis of operating cycles along with specifications, capacity tables and other data on Yoder standardized series of uncoilers, slitters, recoilers, coil cars and scrap choppers. It is illustrated and completely indexed. Copies may be obtained by writing to Dick Burt, Adv. Mgr., The Yoder Co., 5500 Walworth Ave., Cleveland 2, Ohio. **Circle 316**

Eyeleting Machines

For users of eyelets and others who have fastening problems which can be solved with eyelets, 48-page catalog outlines experiences in the design, development and production of eyelets and eyeleting machines for such industries as metalworking, rubber, plastics, electrical, electronic, apparel, paper products and packaging. Copy of this catalog is available by letterhead inquiry to Eyelet Dept., United Shoe Machinery Corp., 140 Federal St., Boston 7, Mass. **Circle 317**

Chucking

Cost and time saving advantages of air operated chucking systems described in detail in illustrated 8-page Bulletin PO-66D; in addition to complete listing of line of air chucks and cylinders, brochure offers considerable information on typical applications with details of installation. The Cushman Chuck Co., Hartford 2, Conn. **Circle 318**

Diamond Dressing Tools

Four-page illustrated folder present company's concept in precision diamond dressing tools which involves orienting diamonds in holders in order to increase tool life and reduce maintenance and replacement costs; outlines all basic dressing tool types and discusses particular uses of each type. Permattach Diamond Tool Corp., Milford, N. H. **Circle 319**

How Brown & Sharpe "STANDARD" End Mills End Wonder, Worry & Wait!
"Standard" B & S 4 flute, ½", taper shank end mill cutting cam track in annealed steel.
"Standard" B & S 4 flute, ⅜", extra long, fast helix end mill peripheral milling vertical slot note: square end and bottoming cut.
"Standard" B & S 2 flute, 3/16", straight shank, double end end mill cutting key slot in arbor—note: double end doubles production before resharpening.
"Standard" B & S 4 flute, ½", fast helix, double end end mill plunge cutting and slotting boiler plate.
CHOOSE FROM 1065 DIFFERENT "STANDARD" OFF-THE-SHELF END MILLS AND PRODUCE JOBS LIKE THESE—IN THE TIME YOU USED TO WAIT FOR OTHER TOOLS!
Here are just a few of the production jobs that are completed and shipped daily—ahead of schedule—by Brown & Sharpe End Mill Users.
Rely on your Brown & Sharpe Distributor for speedy service from a stock of 1065 different end mills.
Send for the B & S "Condensalog" to: Cutting Tool Division, Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.
Brown & Sharpe
CUTTING TOOL DIVISION
HIGH SPEED STEEL CUTTERS
NELCO CARBIDE TOOLS
END MILLS
B·S
FOR THAT EXTRA EDGE IN PRODUCTION
INDUSTRIAL DISTRIBUTION
THE RIGHT HAND OF PRODUCTION
USE READER SERVICE CARD, CIRCLE 49

.....readers' viewpoints

. . . bending tubing ells

To the Editor:

I enjoyed reading Mr. Juleen's article on bending short (small) radius ells in the June issue. However, there are several impressions left by this article which are at variance with historical data.

Example: "Early in 1957, tooling developments in bending machines made possible the forming of stainless steel tubes with radii of less than twice the tube diameter." At Wallace Supplies Mfg. Co., we have been equipping firms for many years with machines and tools to bend tubes as large as 10 and 12 inch to radii of 1½ to 2 inch diameter. Incidentally, North American Aviation had such a machine in 1940 to bend to a 1⅛ diameter radius and 3 inch OD by 0.062 inch wall to ⅞ inch diameter radius and 3 inch OD by 0.049 inch to a 1⅛ inch diameter radius.

As for the forming of a continuous series of bends by plane reversal and separation later by sawing, a tooling setup of this type was supplied to the Fedders-Quigan Corp. in 1946. These bends were less than two diameters. There were no cleats used and the tools were so designed that only the first and last ell required a trim cut. All others were made with a single separating cut.

E. J. De Witt, Pres.
Wallace Supplies Mfg. Co.
Chicago, Ill.

ED.—The reference to 1957 in the article was intended to document two previous articles published during that year and tabulated at the end of Mr. Juleen's article.

. . . heart surgery

To the Editor:

I don't know much about the artery system of the heart, but I've had to make quite a few by-pass gadgets to be used on neoprene and gum rubber tubing which were quite successful.

If you could send me some information on the general size and structure of the type artery in question and possibly a sketch of one of the by-pass clamps in use, I might possibly be some small help.

M. G. Disken
St. Petersburg, Fla.

To the Editor:

I read Mr. DeVos' letter to the editor of THE TOOL ENGINEER with considerable interest. From the description, I imagine the problem to be similar to the attachment of metal fittings to a garden hose. If true, I think I might have a solution, but require more information.

1. What are the size limitations on this "fitting?"
2. How far can a sleeve be inserted into the severed artery?
3. To what extent can the artery be stretched over an inserted sleeve?
4. What is the variation in the arteries?

With more information on this subject I hope I may be of assistance.

Murray Combs
Mechanicville, N. Y.

To the Editor:

I am interested in Mr. DeVos' plea for apparatus needed in heart surgery. There seems to be hardly enough data to even start. I would be interested in seeing a more detailed account of the problem.

Frank L. Cheever
Oakhurst Rd.
Hopkinton, Mass.

ED.—A more complete description of the equipment used in the heart operation has been given in the May issue of THE TOOL ENGINEER on page 88. Additional information of the technical aspects of the problem are being forwarded by Dr. Crook of the Cardio-Vascular Research Association.

. . . suppliers directory

To the Editor:

I would like to extend my congratulations to THE TOOL ENGINEER for its outstanding Suppliers Directory in the June 15 issue.

The Directory saves me many minutes per week as compared to using other industrial directories. Getting in touch with a local sales office by phone, rather than writing or telephoning the manufacturers of various products cuts the costs of getting product information tremendously.

Harold A. Sanders
Ford Motor Company
Dearborn, Mich.

STYLE AND SIZES FOR ALL MACHINES ON WHICH THREADS ARE CUT

On Brown and Sharpe, and other automatics

INSERT CHASERS SAVE UP TO 33%

Insert chasers are like safety razor blades: they cost so little that you can throw them away when dull. Or, for utmost economy, you can resharpen them over and over again. Only a flash grind is required. For approximately $50 you get a dozen sets of ¾—16 insert chasers, each set ground ready to go. You will be amazed at the quantity of threads they will cut, even to Class 3 specifications, with a minimum of downtime. FREE: "Unified and American Screw Thread Digest".

THE EASTERN MACHINE SCREW CORPORATION 27-47 Barclay St., New Haven, Conn.

USE READER SERVICE CARD, CIRCLE 50

technical shorts

Angle Measuring System

DEVELOPMENT of an electromechanical angle measuring system that provides a continuous decimal display of the measured angle in degrees and thousandths of degrees has been jointly announced by Colorado Research Corp. and the Norden Div. of United Aircraft Corp.

Designated the BRL-5 after the Army's ballistic research laboratories of the Aberdeen Proving ground, who sponsored the development of the instrument, the system provides continuous information of shaft angle to resolution of 360,000 parts in a turn. Output is in decimal and 8-4-2-1 binary coded decimal form. An in-line decimal display is also provided.

The system consists of a small transducer and a set of electronics. Vernier signals are also provided by two tone generators in the transducer, one of which is attached to the input shaft. The phase shift between the two signals is continuously measured. A 360-count 8-4-2-1 BCD V scan self-selecting encoder furnishes degree information.

* * *

Cold Extrusion Cuts Scrap Losses

Scrap loss in the production of steel rotors for automotive door latches has been practically eliminated by the use of cold extrusion dies at the M & S Manufacturing Co.

The rotor, a fairly complex shape, has been produced in at least four entirely different ways. One such method was machining from a special cold-drawn rotor section—an operation that is still in use but which requires considerable machining and a waste of 65 percent of the section in steel chips. An extruded shape was tried also but was not ideal because of an integral spindle on the rotor.

Greatest economy has been achieved with the cold extrusion die process. Rotors are formed in two hits on a round slug of steel. They are produced at the rate of 50 per minute on one press. Slugs for the operation are cut off ¾ inch round 1010 cold-drawn bar stock made by Jones & Laughlin Steel Corp. This material is aluminum killed to a fine grain structure and annealed to a maximum hardness of 65 R_B.

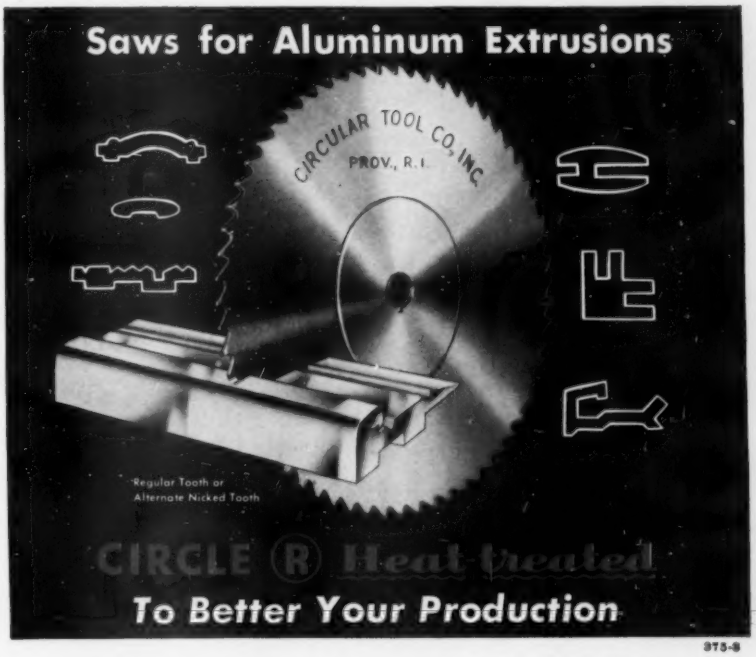
Extrusion operations are performed on a 500-ton press. Two parts are made simultaneously on eight rotating dies. The slugs are reduced slightly in length. Metal in the ⅜ inch wide rotor teeth is squeezed out by a reduction in diameter of the integral spindle.

Ductile Titanium Tubing

A new titanium alloy that can be fabricated as easily as unalloyed titanium yet approaches stainless steel in tensile strength, is offered in the form of small tubing.

The material, known as 3 Al-2.5 V titanium alloy, was developed by Superior Tube's metallurgical department to fill the need for a material that would compete with stainless steel in strength, yet be ductile enough to be cold-drawn into small tubing. Previous alloys could be hot-worked, but lacked the ductility for cold working.

Applications for the new alloy tubing include aircraft and missile parts plus process equipment.



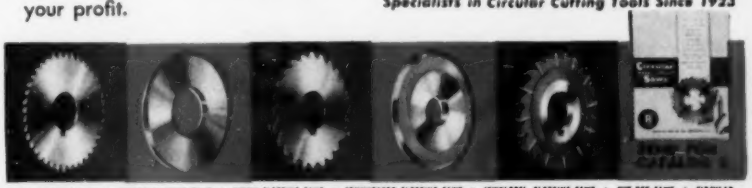
375-B

CIRCLE R saws for cutting aluminum extrusions are specially designed for high efficiency. And exclusive Circle R Heat Treating perfects them with scientific precision — to better your production. Use our know-how to your profit.

Consult these CIRCLE R *Specialists . . .*

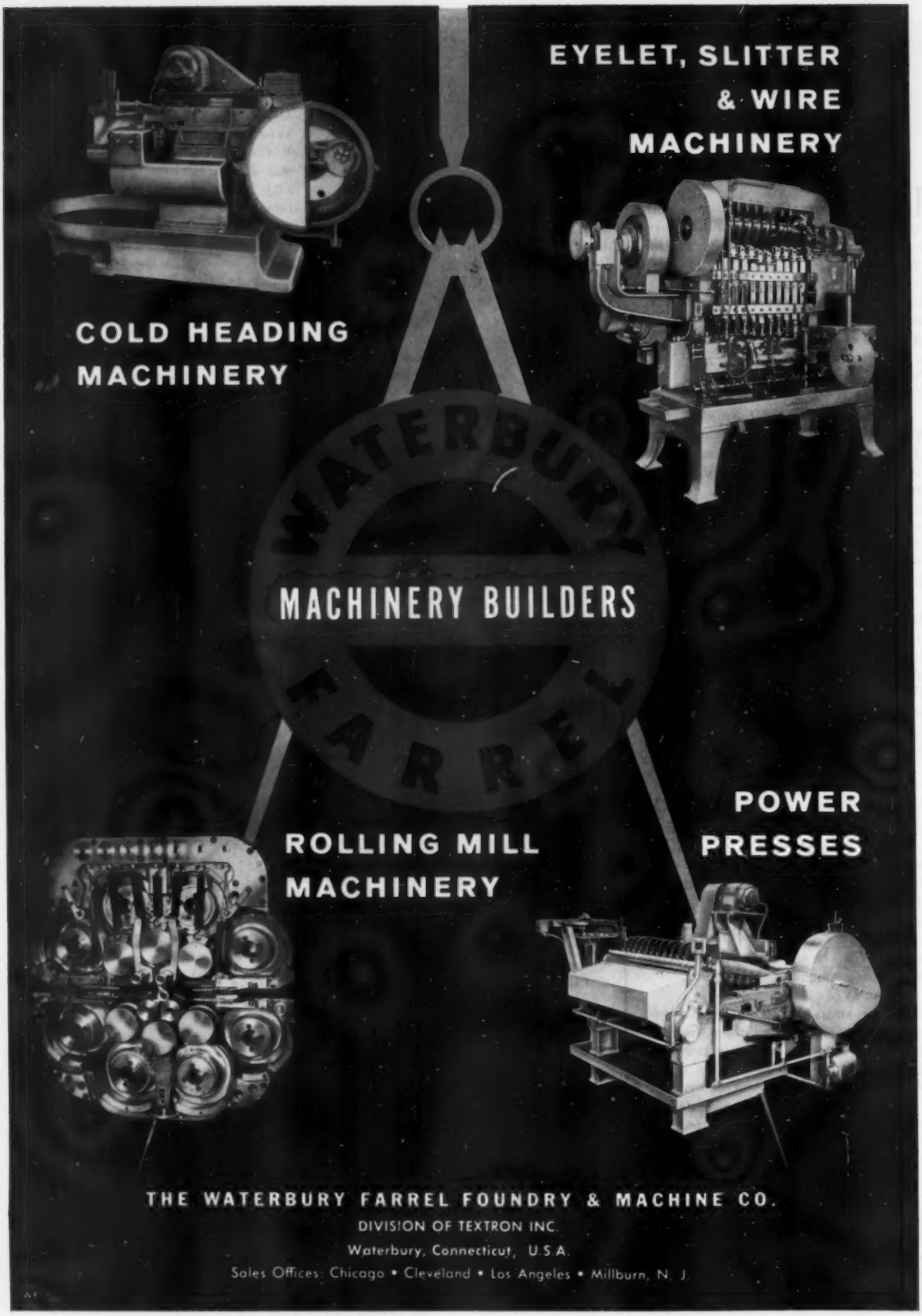
BUREANE — Production Mach. Sales Inc.
CHICAGO — Donald Robertson & Co.
CLEVELAND — Production Tool Co.
DAYTON — J. R. Scott Company
DETROIT — A. D. Sproco
HACKENSACK — The Eaton Company
INDIANAPOLIS — Walter F. Greene & Assoc.
MILWAUKEE — Ford Tool Co.
MONTREAL — Humphrey E. Walton
NEW YORK CITY — J. R. Cremonie (Export)
PHILADELPHIA — General Tool Sales Co.
PHOENIX — DiEugenio Tool Center
PITTSBURGH — Ralph Esposito & Company
PROVIDENCE — Fred J. McMillan
ROCHESTER — James E. Horne
ST. LOUIS — D. C. MacDonald & Co.
WESTBURY, L. I. — The Eaton Company

CIRCULAR TOOL CO., INC.
PROVIDENCE 5, RHODE ISLAND
Specialists in Circular Cutting Tools Since 1923



METAL SLITTING SAWS • COPPER SLITTING SAWS • SCREW SLOTTING SAWS • COMMUTATOR SLOTTING SAWS • JEWELERS' SLOTTING SAWS • CUT OFF SAWS • CIRCULAR KNIVES & ROTARY SHEAR BLADES • CIRCOLOY STEEL SAWS • SOLID & TIPPED TUNGSTEN CARBIDE SAWS • COMBINED DRILLS & COUNTERSINKS • CENTER REAMERS

USE READER SERVICE CARD, CIRCLE 51


EYELET, SLITTER
& WIRE
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PRESSES
THE WATERBURY FARREL FOUNDRY & MACHINE CO.
DIVISION OF TEXTRON INC.
Waterbury, Connecticut, U.S.A.
Sales Offices: Chicago • Cleveland • Los Angeles • Millburn, N. J.

Men at Work

Jacob J. Jaeger, left, has been elected president of Pratt & Whitney Co. He is a senior member of ASTE West Hartford chapter and was recently awarded the ASTE Engineering Citation.

Carl B. McLaughlin, right, has been elected president of Tube Turns Plastics, Inc. He had been executive vice president since the company was founded.

JACOB J. JAEGER succeeds EDWARD P. GILLANE who has been elevated to the position of assistant to the chairman of the board. In this capacity he will work closely with Alfons Landa, chairman of the board of Pratt & Whitney Co. and chairman of the executive committee of Fairbanks Whitney Corp., the parent company. Edward J. Shages, vice president in charge of manufacturing of P & W, was elected to the Board of Directors of the company.

ANDREW T. FISCHER has been named director of product planning of the Remington Rand Univac Engineering Div., Sperry Rand Corp. He has had many years of experience in the electronic data processing field, both in engineering and sales management

The Fluid Controls Institute, Inc. has elected JAMES R. LAWLER, JR. of the Lawler Automatic Controls, Inc., as president at the Spring Meeting. Other officers elected at the meeting were FRED WELDON of General Controls Co., first vice president; ROBERT MCCORMICK of Automatic Switch Co., second vice president; PAUL ROGERS, JR. of Skinner Chuck Co., treasurer; ERIC A. BIANCHI of Mason-Neilan Div. of Worthington Corp., corporate secretary and E. R. RATH of Fluid Controls Institute, executive secretary.

BURR TUPPER has been appointed director of works engineering for the Westinghouse Electric Corp. in Pittsburgh, Pa. Mr. Tupper has been associated with Westinghouse as a staff assistant since 1953. In 1956, he transferred to the Westinghouse Air Conditioning Div., as manager of manufacturing, the position he held until his present assignment in Pittsburgh.

Milgo Electronic Corp. of Miami announced the appointment of EDWARD G. PARSONS as chief engineer and DIXIE B. MCKEY as staff technical consultant. Mr. Parsons had been with Sperry Gyroscope Co. prior to joining Milgo in 1955. Mr. McKey has had thirty years experience in the electronics field.

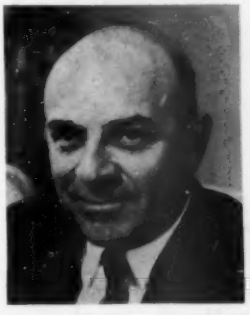
DR. WILLIAM C. KNOPF has been named technical director of the USI Technical Center, Research and Development Div. of U. S. Industries, Inc. Dr. Knopf will direct all technical activities at the center that was established for advanced work in research and development projects for the USI mfg. divisions.

WILLIAM F. FISCHER, JR., has succeeded his father as president of the Fischer Machine Co. and its subsidiary, Scriptomatic, Inc.

JOHN E. ERSKINE has been elected president of Racine Hydraulics & Machinery, Inc., succeeding his father, Malcolm E. Erskine, who continues as chairman of the board. Also named was GEORGE B. MILLER as executive vice president to fill the post. Miller had been vice president in charge of engineering. Another promotion, JAMES E. MOHRHAUSER was made vice president in charge of operations.

National officers for the American Society for Testing Materials elected at the 62nd Annual Meeting in Atlantic City were F. L. LAQUE, vice president and manager of Development and Research Div. of the International Nickel Co. as the new president; MILES N. CLAIR, president of the Thompson & Lichtner Co. has been nominated for vice president; A. ALLAN BATES, vice president of Research and Development of Portland Cement Association will continue as Senior Vice President.

MALCOLM F. JUDKINS, formerly with Firth Sterling, Inc., has been appointed technical director, Commercial Production Engineering of Sylvania-Corning Nuclear Corp. Mr. Judkins will have his headquarters at the company's Hicksville plant. He is regarded as a pioneer and an authority in the atomic energy field because of associations at Los Alamos, Westinghouse Atomic Power Div. and other A. E. C. organizations in related capacities.

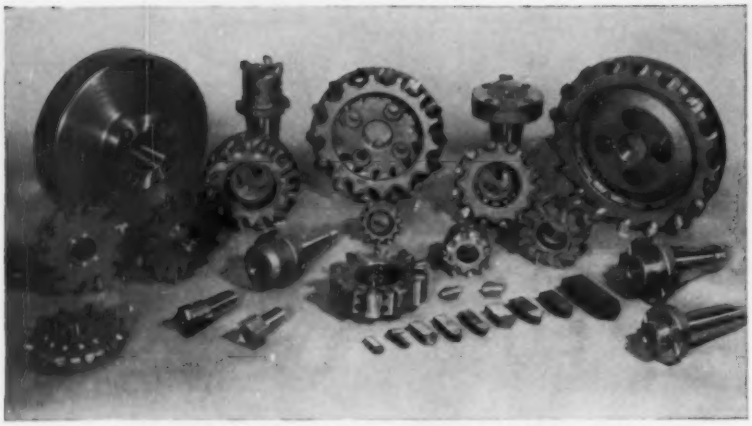


The Activation Div. of Martin Co. has been formed with Vernon Rawlings, left, as general manager.

Howard W. Carlisle, right, has been appointed manager of the Meta-Dynamics Div. of The Cincinnati Milling Machine Co. He has been with various metal-working companies in engineering, sales and management.

M. J. STEFFES, vice president of Super Tool Co., Van Norman Industries, Detroit, has been elected executive vice president. He has been with Super Tool fifteen years in several executive capacities.

E. J. CASSELLA has been elected to his post of vice president of manufacturing for Beaver Pipe Tools, Inc. Cassella came to Beaver in 1954 as assistant plant manager and in 1956 was appointed factory manager.



Milling Cutters — End Mills — Blades — Boring Tools — Arbors — Flywheels

These Lovejoy Products can help you Cut Costs!

The entire line of Lovejoy Milling Cutters and Accessories is designed to aid you in getting better production at less cost.

If you are not now using Lovejoy products, we invite you to do so at first opportunity.

Lovejoy precision-engineered tools include:

Inserted-tooth milling cutters (face, side, end, slotting and boring) which feature husky, forged steel housings; exclusive Lovejoy "positive-locking" blade assembly; a variety of dozens of models and hundreds of sizes.

Blades: H.S.S., Vasco Supreme and carbide. These are interchangeable over a wide range of housing sizes, and Type "A" face milling blades will fit any standard Lovejoy Type "A" cutter of 4½" to 24" dia. All Lovejoy blades are carried in stock, ready for immediate shipment. Special cutters are a Lovejoy specialty.

The New JOYDEX is a real performer!

Among the startling production reports coming in is a motor frame, rough-milled at 26 cubic inches per minute by an 8" diameter JOYDEX. Finish (with sweep blade) was 63 micro inches. Material was 115 Brinnell boiler plate.

Indexable throw-away blades, plus performance like the above, make the JOYDEX a joy to use—for operator, manager and treasurer. May we send you our latest spec sheet?

Catalogs — include: "Face Mill Catalog No. 31; Side Mill Catalog No. 32; Type "S" Bulletin; Arbor Catalog No. 33; "Speed and Feed" Calculator. Write today for copies desired.

LOVEJOY TOOL COMPANY, INC.
Springfield, Vermont, U.S.A.

USE READER SERVICE CARD, CIRCLE 53

Appointment of ROBERT F. SHANNON as general manager of the Detroit Sintered Metals Corp. of Kalamazoo, Mich. to succeed HENRY F. LATVA has been announced by William M. Hankins, Jr., president of the parent company, Bunting Brass and Bronze Co. Mr. Latva has been transferred to the Toledo office on special Assignment. Prior to joining Detroit Sintered Metals Corp., Mr. Shannon had been manufacturing superintendent, assistant to the works manager and plant manager for the P. R. Mallory Co.

LEO YANOFF has been appointed staff engineer, Systems Component Coordination at the Owego facility of International Business Machines Corp. A member of the ASTE Binghamton chapter, Mr. Yanoff began his association with IBM at the Electrical Analysis Laboratory in Poughkeepsie in 1955.

Election of MICHAEL E. ERRICO to the position of assistant vice president was announced by the Board of Directors of Laminated Shim Co., Inc. Mr. Errico, an employee of Laminated Shim for twelve years, was elevated from the position of executive assistant to his new post.

THOMAS H. ARMSTRONG has been named vice president in charge of marketing for Minneapolis-Honeywell's Datamatic Div. in Boston. He assumes direction of an expanded nationwide sales and service force to support the division's new, transistorized Honeywell 800 computer service.

Guy H. Pitts, vice president of manufacturing of Bohn Aluminum & Brass Corp., announced the appointment of EDWARD O. FALBERG as division manufacturing manager. In his new position, Mr. Falberg has responsibility for manufacturing operations of two of Bohn's plants. CARL F. BROWN assumes Mr. Falberg's former duties as plant manager of the Greensburgh plant.

ROYDEN WALTERS, Boston-based Saco-Lowell vice president, will become in addition to his Boston post, executive assistant to the president, executive vice president and assistant general manager of both the Easley and Sanford operations. At Easley, HENRY A. JEWELL, who has been director of procurement and material control at Boston, will become works manager of the Saco-Lowell Textile Machinery Div. At the Gear and Machine Div. at Sanford, Howard J. Haug will move from manufacturing manager to works manager. LEO CARTIER, who recently joined Saco-Lowell's Boston staff, will move to Sanford to become assistant works manager.

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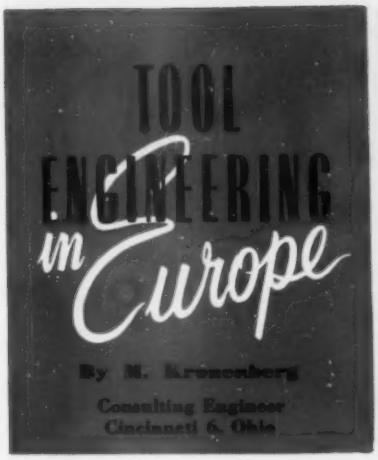


Wear of Carbide Tools

Wear of sintered carbide tools is discussed in an anonymous article in the French periodical *Métaux corrosion-industries*. The title is: "Contribution à l'étude de l'usure des outils de coupe en carbure métalliquefritté" and appears in No. 389, p. 30-51 and No. 390, p. 71-84.

Wear is divided into three categories: mechanical wear that tears projecting particles off the surface of the tool; chemical wear due to frictional heat; and mixed processes caused by temporary welding of particles of the tool to the workpiece. These particles are removed by the chip. Several hypotheses on chip formation and wear are considered.

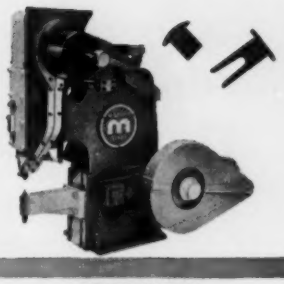
The wear of a carbide tool starts at the crater on the tool face or in the chip breaker; also at the tool flank or as scaling caused by the brittleness of the carbide. Wear criteria are discussed in the article and the preparation of the tools is described. Grinding with a diamond wheel gave better surface finishes than electro-erosion.

The loss in weight due to wear is likewise analyzed and abrasion tests are discused on the basis of cutting performance and temperature.

Cutting Relationships

Chip formation—which affects all the factors in machining processes—is the topic of an article published by R. Fleck in *Industrie Anzeiger*, Vol. 81 (20), p. 291-294 under the title: "Zusammenhang zwischen Schnittkraft, Spanbildung and Verschleiss."

In the author's opinion cutting force alone is no indication of tool life because cutting force varies only slightly with different steels in spite of variation in microstructure. From cutting force tests, however, it is possible to calculate the strain in the shear plane



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when the shear angle is known. It is shown that the strain at the shear plane of the chip is related to chip formation data, rendering it possible to calculate tool life.

Machining Alloy Steels

The effects of various additives in alloy steels have been studied by G. Menges and H. Treppschuh according to an article published in *V. D. I. Zeitschrift*, Vol. 101 (7), 1959, p. 265-273, under the title: "Spanende Formgebung hochlegierter Staehle auf Chrom-, Chrom-Nickel and Chrom-Nickel-Mangan Grundlage."

The authors have analyzed the influence of chrome, chrome-nickel and chrome-nickel-manganese on coolants, tool geometry, tool grinding and so on. Sharp cutting edges are recommended for thread cutting operations. Tools should be lapped or polished when used for machining of high-alloy steels.

Czechoslovak Machine Tools

Developments in machine tool manufacture in Czechoslovakia are discussed by Vilem Roztocil in an article published in No. 8, 1958, of *Czechoslovak heavy industry*. New designs are directed toward semiautomatic and fully automatic work cycles and the development of units to be used for mass production. In 1947 only 142 types of machine tools were produced as against over 200 types in 1955.

Preselection of speeds and feeds has been adopted and copying equipment for lathes and other turning machines has been developed. A vertical milling machine being built by the TOS Kurim Corp. has a 40-hp motor for milling with carbide tools.

Machine rigidity has been increased in order to improve accuracy. For the same reason, new main spindle bearings have been developed and also better guideways. Servo motors are used for clamping the workpiece and controlling the tailstock spindle. Rapid traverse is incorporated in order to reduce nonproductive time and physical effort by the operator.

Hydraulic tailstock and hydraulic carriage operation have been introduced in several new lathe designs. Heavy machine tools up to 140-inch swing are produced by the LZ works at Pilsen. These are equipped with electronic programming controls. It is claimed that these machines have advantages in comparison with foreign types because of higher spindle speeds and low specific weight.

Turret lathes with preselectors for feeds and speeds are likewise mentioned and it is claimed that great progress has been made in ultrasonic ma-

chine tools. High-frequency heat-treating equipment is illustrated and so are automatic welding machines, friction presses, transfer machines and horizontal boring mills. These developments show rapid progress by Czechoslovak industry.

Tool Wear

The microstructure of the materials changes during machining as the chip glides over the tool face, as the result of an interaction of tool and work material. H. Opitz and G. Ostermann have made tests and investigated the material at the tool-chip interface by means of an electron microscope permitting magnification up to 8000:1.

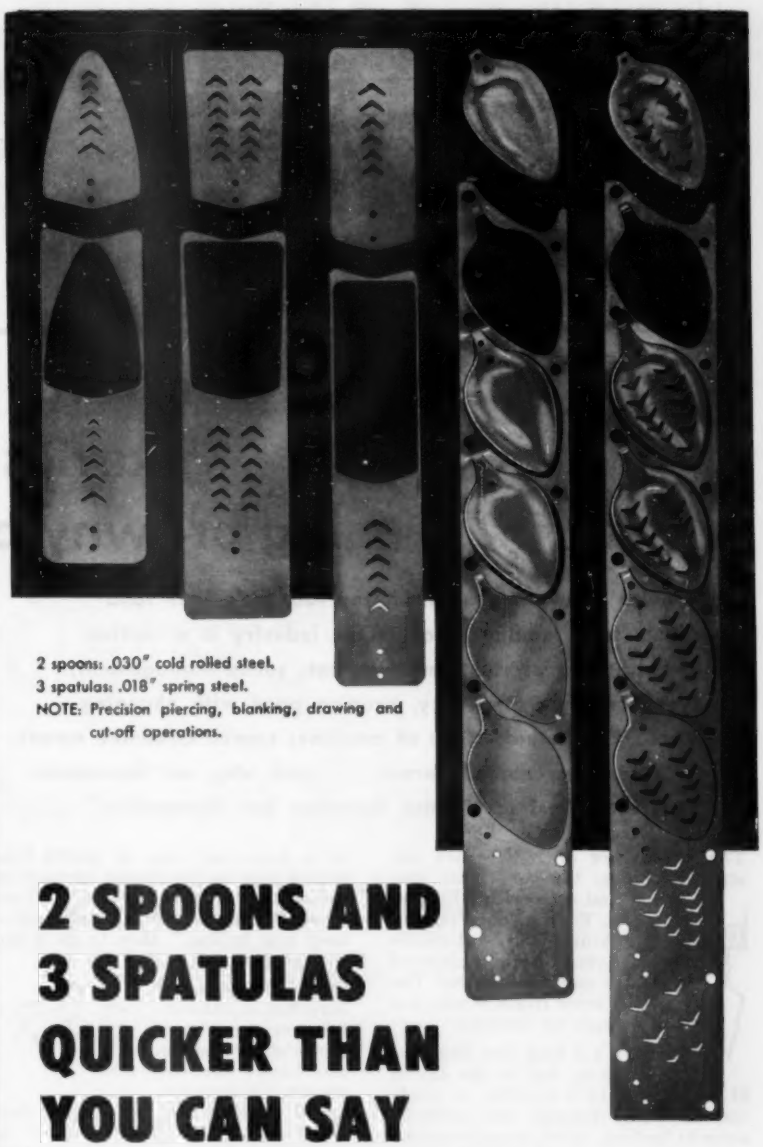
Their work is described in an article in *Stahl und Eisen*, Vol. 79 (1959), No. 8, under the title: "Einfluss des Umwandlungs Verhaltens von Staehlen auf den Werkzeug Verschleiss bei deren Zerspanung mit Meisseln aus Hartmetall Legierungen."

The authors limited their investigations to the chip-tool interface, disregarding the effects at the work-tool interface, and took into consideration only carbon steels of 0.10 percent C, 0.35 percent C and 0.60 percent C. Carbide tools (German Standard S 3) were used with a positive true rake angle of 10 deg and a clearance angle of 8 deg. All cuts were taken with a feed of 0.013 in. and a depth cut of 0.080 in. The low-carbon steel was machined at a speed of 410 fpm; the two higher carbon steels of 460 fpm. This difference is too small for any effect and was accidental due to the fact that billets of the low-carbon steel had a different diameter than the other two steels. The time of each cut was only 15 sec since the steady-state temperature is obtained within that period.

They concluded from their tests that diffusion and welding at the tool chip interface are mainly responsible for wear, and confirmed earlier findings that the heat developed in cutting has a beneficial effect, since slight cracks in the tools can "heal" at certain temperatures.

The main result of the authors' investigation is their conclusion that at the smooth side of a chip a so-called "alpha-gamma" phase takes place in the microstructure of the work material. The austenite phase that is produced at the chip-tool interface determines the reaction with the tool material and hence the wear.

Best cutting conditions are obtained in cases where the microstructural phase change is slowest. (Note: Phase changes may be followed up by means of the iron-carbon equilibrium diagram on p. 192 of the *Tool Engineers Handbook, First Edition.)*



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Torch manufacturer "carries the torch" for big brawny bar automatic!

Growth of a company from the founder's first fond dream to a leading place in the industry is a matter of continuing product improvement, sound management, ever-increasing efficiency, keeping pace with changing times. Read what a line of machines named Greenlee means to a company named Turner . . . and why, out Sycamore-way, they "just love those Greenlee Bar Automatics" . . .

The Great Fire of 1871 struck and scarred Chicago the very same year that enterprising Edward S. Turner "hung out the shingle" at 4 LaSalle Avenue and proclaimed to one and all that The Turner Brass Works was ready for business.

It's a long way from the Horse Age to the Age of H-Power . . . 1871 to 1959. A whole way of living changed, new products came to the fore. Alert, trend-conscious Turner kept pace with the advancing times, moved the factory to Sycamore, Illinois in 1906 . . . expanded its operations steadily until today the Turner Corporation spans 100,000 square feet of factory space, and turns out products ranging from propane torches to plumbing fixture fittings—blow torches to diesel engine starting aids — camp cook-stoves and lanterns to furnaces and furniture hardware.

Along that route Turner continually met the old familiar problem: *How to get high-speed production and maintain top quality.*

That's where Greenlee enters the picture, and the Case of the Propane Torch is a typical example. It's a "How-They-Dunit" that may hold eye-opening suggestions for some of *your* production problems.

Turner's Propane Torch suddenly became a "hot" item — hot as its glowing tip. An expanding nation-wide need for it in home and shop at length blossomed into an enormous increase in demand. The order went out: "Turn 'em out faster — but keep quality up — keep cost in line." How to do it was the question.

Turner management launched an exhaustive investigation of top-rated production machines on the market. They probed, tested, ran trial runs. Eventually they found a machine that seemed to do everything they asked. It took 9/16" round brass stock, gave it a merry whirl — 298 surface feet per minute on stock diameter—2029 revolutions per minute.

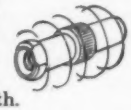
Quality tested consistently high, rejects were held to a minimum, a complete operation was eliminated, as the husky Greenlee Bar Automatics "rolled 'em out" with the tireless gait of a 'round-the-clock marathoner.

That's when a long and happy association began. For shortly thereafter, the Turner P.A.'s signature was on a purchase order for a battery of Greenlee Automatics with special attachments.

A look at the Job Progress schedule will give you an idea of how efficiently they tick off a 6-stage operation on mixer tubes:

1st Position:
The big Greenlee Cam-Feed 1-5/8" Six-Spindle Bar Automatic uses a 1" tool slide stroke with .0063 inch feed on the endworking tools. Stock is fed out to length during indexing, spot-drilled, knurled (using a standard plunge-type knurl holder and a two-roll roller rest).

2nd Position:
The mixer tube is faced by a knee turner while a .277 inch diameter drill, mounted on a high-speed drilling attachment, drills to depth.



3rd Position:
Outside diameter is sized by a standard dovetail form tool. A .187 inch hole is drilled partway, as a two-roll roller rest supports the part.

4th Position:
Using a standard milling attachment mounted on the tool slide, the two parallel flats are milled. (Attachment consists of two milling cutters mounted on a keyed arbor in the milling head). Milling head rotates at the same r.p.m. as the workpiece; internal gearing in the attachment rotates the milling cutters at proper speed for the milling cut.

5th Position:
The .187 inch hole is drilled to depth while a standard cut-off tool breaks down for cut-off.

6th Position:
A 5/16" — 27 thread is tapped, and the part is cut off.

FINAL SCORE:

580 high-quality mixer tubes per hour at gross production rate. One complete operation eliminated. Rejects at an all-time low. . . . No wonder, out Sycamore-way, they "just love those Greenlee Bar Automatics" — big — brawny — and *bears for the jobs where you've got to keep your quality reputation as you keep up with market demand.*

Question:
Have *you* looked into Greenlee, lately, for quality on a production basis?

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154	164	174		304	314	324	334	344	354	364	374	384	394		404
155	165	175		305	315	325	335	345	355	365	375	385	395		405
156	166	176		306	316	326	336	346	356	366	376	386	396		406
157	167	177		307	317	327	337	347	357	367	377	387	397		407
158	168	178		308	318	328	338	348	358	368	378	388	398		408
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Field Notes

The John Crerar Library, one of the world's largest collections of technical, scientific and medical literature, will move to the Technology Center campus of Illinois Institute of Technology. The Crerar Library will have custody of the Illinois Institute's technical library collection and will be located in a new public library building to be constructed on the Illinois Tech campus. The library will continue to be under the jurisdiction of the Crerar board. Illinois Tech will turn over its estimated 125,000 engineering and scientific books and periodicals to the custody of the Crerar board and to the administration of the Crerar Library staff. The Crerar Library has approximately 1,000,000 books and periodicals of all classifications.

expansions

Chrysler of Canada will construct an aluminum die-casting plant at Windsor, Ont. Aluminum ingots for the plant will be supplied by Chryslum, Ltd., a new jointly owned company that is being formed by Chrysler Corp. of Canada, as majority owner, and by Aluminum Company of Canada. The new company will furnish a major portion of aluminum ingots needed by Chrysler of Canada and a portion of ingots required by Chrysler Corp. Production of oil pump and water pump components and clutch housings is scheduled to begin during 1960 model production with other types of castings to be added later.

V V V

Philco Corp. has begun construction on a new multimillion dollar Transac computer center. The new plant, with over 200,000 square feet of floor space, will contain national sales offices and research, engineering and manufacturing facilities for producing the Transac S-2000 large-scale electronic data-processing system and Philco's industrial process control and mobile field computers for the military.

V V V

A new mill branch warehouse and specialty steels service center serving eastern Pennsyvlania's Delaware Valley, has been opened by The Carpenter Steel Co. in Fort Washington Industrial Park and Office Center in suburban Philadelphia. The new service center is the 20th combination office and warehouse to be added to Carpenter's nationwide chain and was established to meet the increased demand in the Delaware Valley for specialty tools, stainless, alloy, high-temperature, and electronic steels.

new facilities

The Ductile Iron Foundry of Rock Island, Inc., located at Rock Island, Ill., began operations April 15, 1959. A licensee of the International Nickel Co., this new ductile iron jobbing iron foundry will have a capacity of 40 to 60 tons of good castings per day. Fifty-eight-thousand square feet of floor space includes a 26-station Link-Belt, overhead mechanized sand and molding system, plus a complete laboratory for chemical and physical testing. This new jobbing foundry is the only one of its kind between Chicago and Denver.

V V V

Firth-Sterling, Inc. has commenced construction of new melting facilities and a new building to house its newly acquired Hopkins process. The melting facilities, located at McKeesport, Pa., consist of forming machines, three of which will be transferred from the Kellogg plant in New Jersey. The machines are capable of producing ingots up to 15 inches in diameter, weighing 3300 lb. A new melting machine will be installed capable of producing ingots up to 20-inch diameter, weighing approximately four tons. The new melting facilities will have a combined capacity of 800,000 lb of metal per month.

V V V

Solar Steel Corp. has initiated production within the new facilities of its Union, N. J., plant. Solar entered the roll-forming field as a result of their purchase of the Mechanical Steel Tubing Corp., New York City, N. Y.

V V V

Plans for construction of a modern research center on a 12-acre landscaped site in Solon, Ohio, were made public by the Warner & Swasey Co., Cleveland. Specific research facilities will include separate machine design and systems areas, a design and test section for servo mechanisms, a special humidity-controlled design and experimental area for textile machinery, metal-cutting and metallurgical research laboratories, plus a prototype shop capable of fabricating full-scale working models of new product designs. Construction is expected to be completed by the end of this year, with dedication in 1960 at the time of the company's 80th anniversary.

new activities

Consolidated Systems Corp. has signed an agreement with Transdynamics, Inc. under which Transdynamics will provide engineering and manufacturing liaison between CSC and users of instrumentation systems in the Seattle-Richland area of Washington. Consolidated Systems is a wholly owned subsidiary of Consolidated Electrodynamics Corp. Transdynamics is an application engineering firm with headquarters in Burbank, Calif.

V V V

Sylvania-Corning Nuclear Corp., a manufacturer of nuclear fuels and reactor components, has arranged to purchase a share in the French company CERCA (Compagnie pour l'Etude et la Realisation de Combustibles Atomiques). Under the agreement, which is subject to obtaining necessary or appropriate governmental rulings and approvals, Sylvania-Corning Nuclear Corp. will be joint owner of CERCA, together with Saint Gobain, Pechiney and S.F.A.C., leading French manufacturers and present co-owners of CERCA. This is announced as the first commercial nuclear fuels production organization with American and European participation, specifically set up to participate actively in the Euratom market.

V V V

Development of the first die-castable metal alloy for service above 500 F was revealed by The Dow Chemical Co. The alloy, designated HM11XA, is a member of the magnesium-thorium group and contains one percent thorium, one percent manganese and the balance magnesium. The new alloy retains good mechanical properties through 800 F, according to Dow. Several parts are currently being evaluated in aircraft and missile applications. The alloy can be die-cast in regular equipment with a minimum of changes from standard procedure.

association news

The Powder Metallurgy Equipment Association, a trade division of the Metal Powder Industries Federation, announced that a new class of associate membership had been opened to service and supply organizations, such as tool and die makers, gas atmosphere suppliers and related companies. The move

was made by the corporate members of the association, which include compacting press and sintering furnace manufacturers in order to facilitate the establishment of standards and foster technological exchange for the rapidly expanding powder metallurgy industry.

V V V

The American Welding Society has invited authors to submit papers on welding or related subjects for presentation at its 41st annual meeting and welding exposition at Los Angeles, April 25-29, 1960. Abstracts of papers must reach AWS not later than Aug. 15, 1959, to insure consideration for the Los Angeles program. Abstracts should contain not less than 500, but preferably not more than 1,000 words. Papers dealing with the educational informative categories of welding production, engineering, research and metallurgy are welcome as long as the subject falls within the field of the Society's activity. Copies of the authors' application forms may be obtained from the American Welding Society, Dept. P, 33 W. 39th St., New York 18, N. Y.

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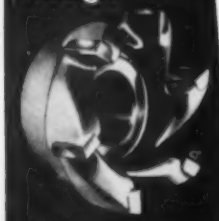

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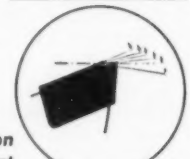
1 FASTER, EASIER, REGRINDING
Coromant teeth are seated at higher angle than is required by the radial rake. You simply grind a suitable primary land along the cutting edge rather than taking off the entire top surface of the blank as required by conventional type. Coromant saves time and grinding wheels.

2 LONGER TOOL LIFE
Streamlined Coromant body minimizes the amount of carbide removed in regrinding. You retain far greater tip thickness for the life of the cutter than is possible with conventional designs.

3 EASIER, MORE ECONOMICAL CHANGE OF RADIAL RAKE
Coromant cutters have extra "angle capacity" . . . require less carbide removal.



For complete data on all sizes of these Coromant mills ask for this free folder.

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A survey conducted by the National Tool and Die Manufacturers Association, in personal meetings with manufacturing executives of ten leading American corporations, have disclosed that representative American companies in the automotive household appliances, business machines and aircraft industries, were not purchasing tools and dies abroad except for trial purposes. The study indicated that the manufacturers had no intention of purchasing tools and for the most part planned to continue placing the major portion of their tooling work with independent American contract tool and die plants.

V V V

The National Applied Mechanics Conference, sponsored by the American Society of Mechanical Engineers, will be held at Rensselaer Polytechnic Institute, Troy, N. Y., June 18-20. Elasticity, vibrations and hydrodynamics are the topics speakers will cover. Thirty papers will be presented in the four sessions and among the contributors are experts from Japan, England, Formosa and New Zealand. Featured speaker at the conference banquet on June 19 will be Clarence E. Davies, coordinator for the new United Engineering Center.

moves

Huck Manufacturing Co. has moved its western branch to new and larger facilities in suburban Los Angeles. The new building at 220 N. Daphne in Hawthorne, Calif., provides more than double the space formerly occupied by the branch at its Inglewood location. The Western branch building houses a large warehouse for fastener and tool stock, a service facility for Huck fastener installation tools, and executive offices for Huck's Western Sales Div.

acquisitions

Hupp Corp. has purchased the valve operator division of Cutler-Hammer, Inc. Manufacturing operations will be moved from Milwaukee to the Chicago plant of the Hupp Aviation Co. division. Hupp Aviation will be responsible for service of Cutler-Hammer valve operators now in service. The Hupp-made product will be known as Electrodyne valve actuators.

V V V

Hommel Corp. of Grove City, Pa., a manufacturer of powered screwdriver bits, has been purchased by Vermont Tap & Die Co. Machinery and equipment for manufacturing Hommel powered screwdriver bits will be moved immediately to the Vermont plant in Lyndonville, Vt.

Norton Co. of Worcester, Mass. has purchased the inventories, machinery and equipment with drawings, designs and other assets of Gould & Eberhardt, Inc. of Irvington, N.J. All assets will be moved to Worcester in the near future. Manufacturing of the line of shapers and gear hobbing machinery will be continued in Worcester at Norton's machine tool plant.

V V V

Scully-Jones and Co. announce the acquisition of the complete line of Tychoway bearings, a new recirculating roller type bearing for friction-free linear positioning.

V V V

Dana Corp., Toledo, Ohio, has announced the acquisition of the Rzeppa constant velocity universal joint assets of the Gear Grinding Machine Co. of Detroit, Mich. Rzeppa will be operated as a separate division of the Dana Corp. and will remain in its present facilities in Detroit, Mich.

new companies

Machine Sales West has been formed as a subsidiary company at its Western Division plant in Van Nuys, Calif. by The Torrington Mfg. Co. The new sales organization is responsible for sales and service west of the Mississippi River of all metal forming equipment produced by Torrington Mfg.'s Machine Div.

V V V

Chemical Milling International Corp. has been formed by Frank L. Bailey and E. Lawrence Brevik. The company will be engaged in the production, consulting and research of chemical milling.

awards

The Borg-Warner annual award for achievement in the field of missiles and astronautics will be presented this year to the Rocketdyne Div. of North American Aviation, Inc. Rocketdyne was singled out for this honor in recognition of the Division's successful development during the past year of a majority of the liquid-propellant engines which have helped the United States achieve its objectives in the technology of weaponized and fielded ballistic missiles, as well as in the country's first successful space probes and satellites.

Achieve efficient, automatic production, and produce more all along the line, by integrating equipment designed and built by AUTOMATION for automation.

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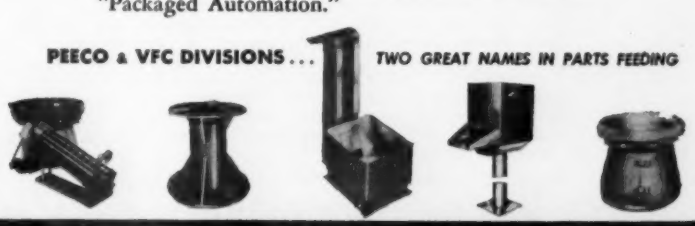

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good READING

MARKS' MECHANICAL ENGINEERS' HANDBOOK—*Revised by Theodore Baumeister. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $23.50. 2270 pages.*

This well-known handbook has been revised and contains data on practically every branch of mechanical engineering. It covers theory, standards and practices found in such diverse fields as aeronautics, compressors, computing machines, heat transmission, industrial engineering, machine elements, machine shop practice, marine engineering, pumps, strength of materials and vibration. These subjects are only a few covered by the 18 major sections. The book has been compiled by over 90 experts that are specialists in their particular fields. It has been completely revised and updated to keep the available data abreast of many important developments in the mechanical engineering field.

ANALYSIS & CONTROL OF NONLINEAR SYSTEMS—*by Y. H. Ku. Published by The Ronald Press Co., 15 E. 26th St., New York 10, N. Y. Price $10. 360 pages.*

This book provides electrical and mechanical engineers, physicists and applied mathematicians with a practical and up-to-date account of available techniques for analysis and control of nonlinear physical systems. The material has been developed as a graduate course in nonlinear circuit analysis. Being used as a text for such a course, 120 problems are included at the end of the book.

Both the analytical and topological methods of solving nonlinear differential equations are presented covering both mechanical vibrations and electrical oscillations. Physical examples in both mechanical and electrical systems which involve nonlinearities are worked out in detail. The special feature is a thorough treatment of the third and

higher order nonlinear differential equation. A new approach has been developed based on the author's method of space trajectory and N dimensions which extends the phase plane method to phase space.

NUCLEAR ENGINEERING HANDBOOK—*Edited by Harold Etherington. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $25. 1872 pages.*

Nuclear engineering is comprehensibly covered in a standard handbook form at a practical level for engineers interested in industrial and other applications of nuclear energy. The theory of engineering principles and techniques as well as reference material on nuclear energy are covered by a number of experts in this field. Major categories of information include basic data used in nuclear engineering, formulas and methods of calculation used in the reactor design, present state of the technology, descriptive reviews of nuclear theory and engineering principles. Seventy contributors have supplied data on their specialties in nuclear science and technology.

MILLING, DRILLING AND TAPPING FOR DIFFICULT TO MACHINE MATERIALS—*Published by the Metal Cutting Tool Institute, 405 Lexington Ave., New York 17, N. Y. Price $1.00. 24 pages.*

Current uses of high-strength materials in jet engines, high-speed aircraft and missiles have caused manufacturers to develop much interest in machining these new materials. This book covers the problems of milling, drilling and tapping work materials like titanium and titanium alloys, super-strength steels, high-temperature alloys, stainless steels and other similar materials. General machining data are found in a section that brings out factors that have been found helpful in shops that have had experience in machining these materials. Specific recommendations on tool design and operating conditions are detailed under each material heading.

. . . New ASA Standards

Copies available from The American Standards Association, Inc., 70 E. 45th St., New York 17, N. Y. For ASTE members, copies may be obtained from National Headquarters.

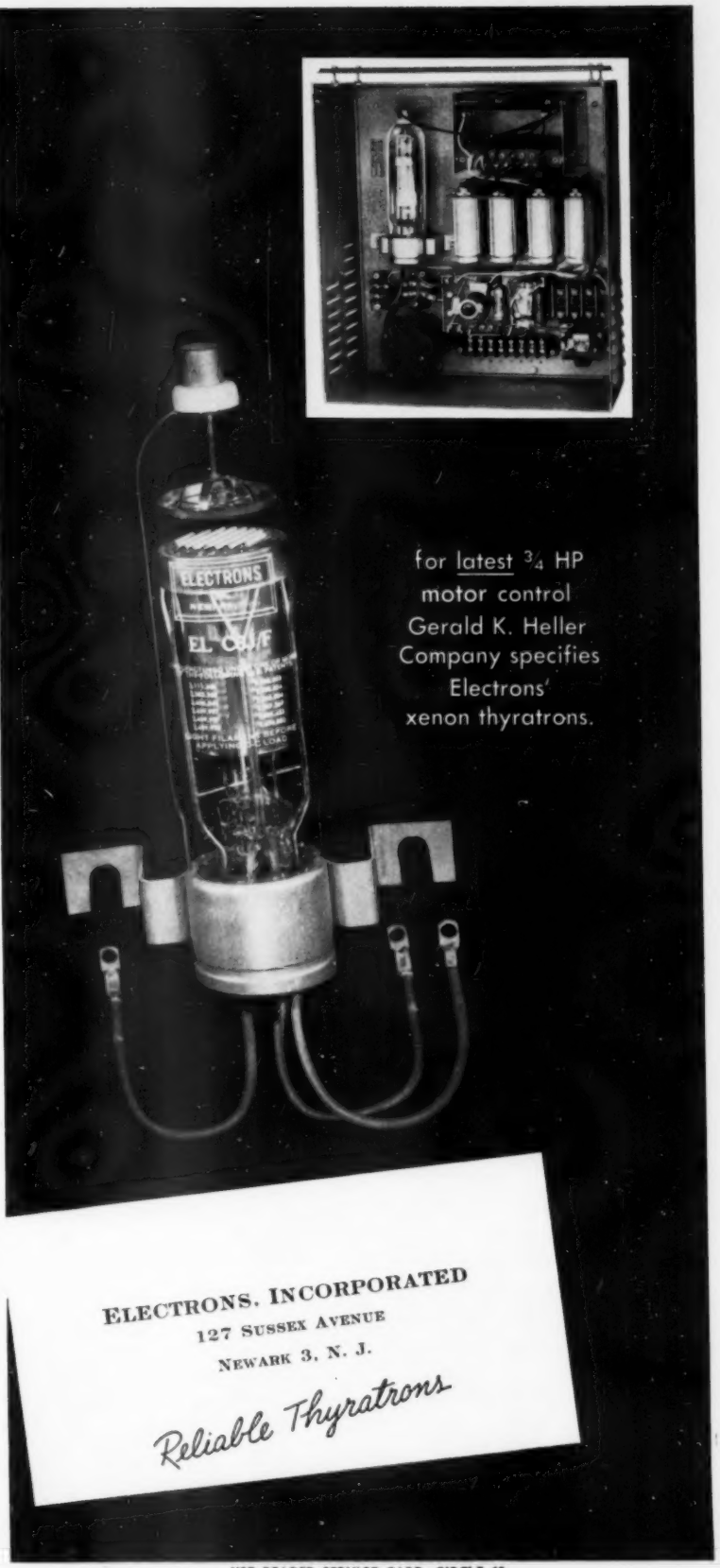
B3-10-1959, INSTRUMENT PRECISION BALL BEARINGS, REQUIREMENTS FOR. PRICE $1.

B5.14-1959, REAMERS. PRICE $2.50.

B5.38-1958, DRIVING AND SPINDLE ENDS FOR PORTABLE AIR AND ELECTRIC TOOLS. PRICE $1.50.

B27.1-1958, LOCK WASHERS. PRICE $2.

B5.12-1958, TWIST DRILLS. PRICE $2.



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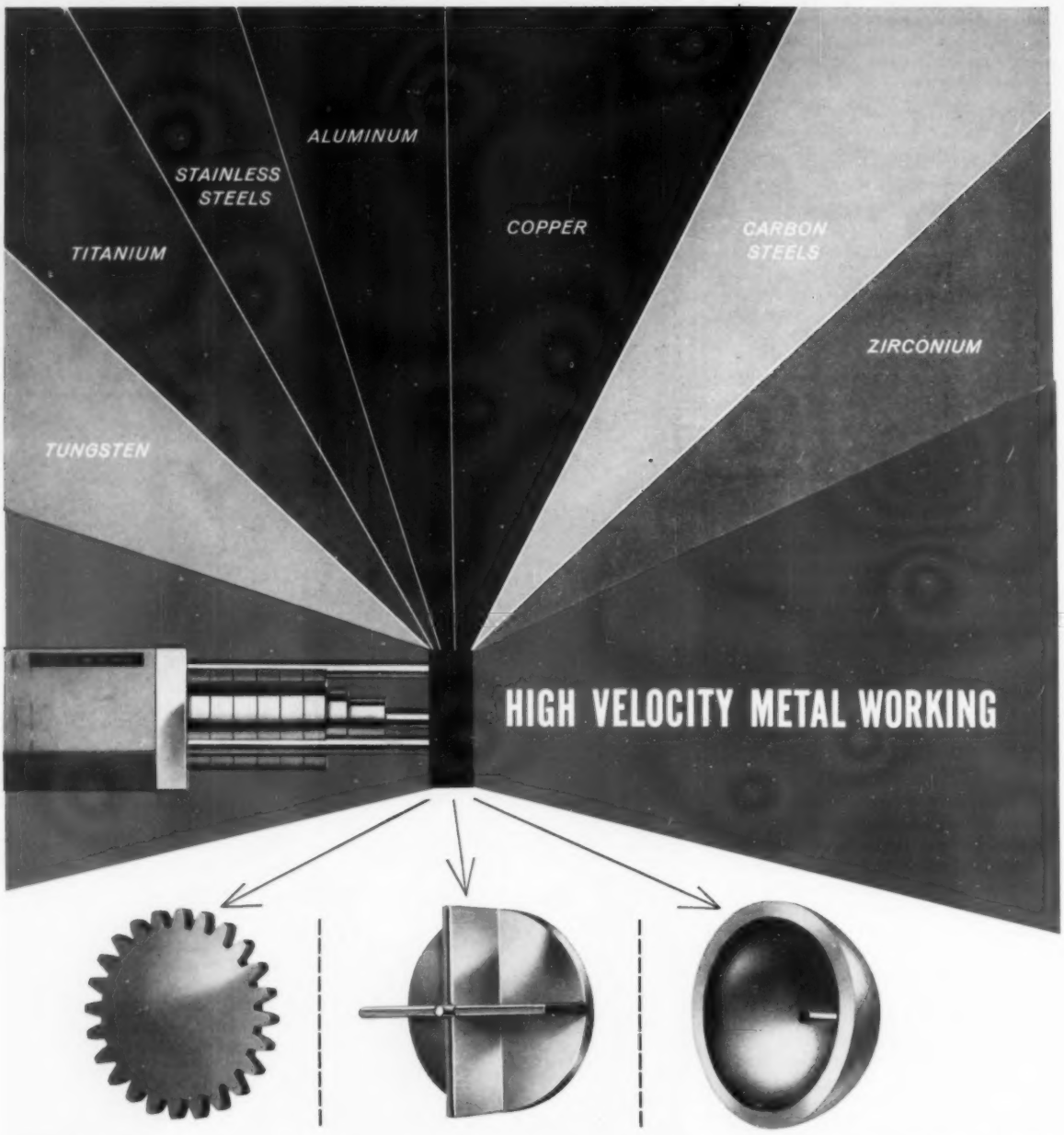

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Tech Digests

Diffusion Bonding of Carbide to Steel

Jerome F. Kuzmick, Pres.
and
Glenn B. Goodfellow, V. P.
Powder Alloys Corp.
Clifton, N. J.

DESPITE RECENT IMPROVEMENTS in techniques, there are still many potential applications for tungsten carbide tools which cannot be utilized because of weakness of the joint between carbide and steel. Mechanically clamped joints cannot take heavy impact or high temperatures, brazed joints are not always dependable as it is difficult to completely "wet" carbide with molten brazing alloys, and flame-plating is limited to simple shapes and thin coatings.

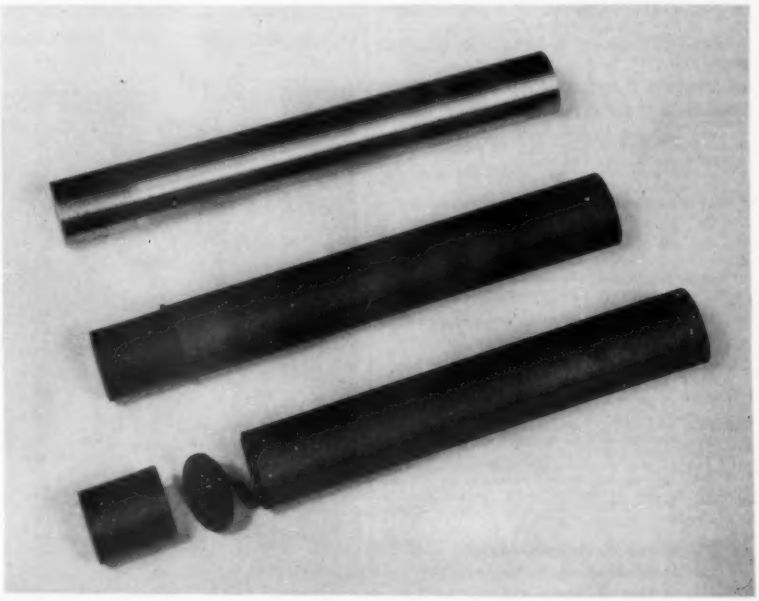
The problem of bonding carbide to steel has been attractive with regard to the possibility of using powder metallurgy techniques to develop special bonding materials. About one year ago, work was started on a new material and method that shows promise of widening the uses for tungsten carbide-tipped tools, because of the greatly increased joint strength. The new material is named Plymet and is produced by powder metallurgy technique.

The material is produced as a thin wafer molded from a metal powder mixture, and subjected to a low temperature sintering operation. High temperature brazing or welding flux is usually admixed with the metal powder prior to molding, or impregnated after sintering. As a result, the wafer is self-fluxing in the subsequent bonding operation. The sintering is actually a presinter, performed primarily to increase the handling strength of the wafers. At this stage, no discernible diffusion or alloying of the metal powder mixture within the wafer has taken place.

In the bonding operation a wafer slightly larger than the carbide tip is placed between the carbide and the steel shank, and the assembly is subjected to pressure of about 500 psi. Pressure is maintained while the joint is heated to a temperature of about 1900 to 2000 F for 30-36 sec. During the heating cycle, flux coats the joint. The portion of the wafer covered by the carbide, and thus subjected to pressure, compresses about 15-20 percent in thickness, eliminating most voids, and resulting in a joining metal hardness of about R_C 45. Excess material outside the carbide is not compressed and remains soft and friable, which makes it easy to remove by filing or sanding. Unlike brazing, it does not melt during the bonding operation.

Even though time, temperature and pressure of bonding are low in order of magnitude, complete diffusion of the metal powders in the wafer takes place, as well as bonding at the interfaces. As a result, a strong, shock resistant joint is developed.

Those dealing with tungsten carbide know that it has a coefficient of expansion about one-half that of steel. This creates a problem upon cooling a brazed or otherwise bonded carbide to steel part. The greater contraction of the steel creates stresses in the carbide which often cause cracking of the latter, either immediately upon cooling or hours or even days later. Methods are used to cushion this shock by sandwich brazing or by use of interposed materials having a coefficient of expansion intermediate between that of carbide



Carbide-tip punch in various stages of assembly. The three component parts are located at the bottom; the center bar is shown as bonded together and the finish ground punch, top, shows that the joint is almost invisible.

Gaertner Toolmakers' Microscope used to measure typical piece part. Co-ordinate range 4" x 2".

Precise measurement to 0.0001" and 1 min. of arc

Gaertner Toolmakers' Microscope

Here is a reliable, easy-to-use microscope for precise measurement of piece parts, tools, dies, thread gages, templates, jigs, fixtures, etc. Ideally suited for making a wide variety of precision measurements and is especially valuable in reducing rejects in production work.

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Features that assure you of
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- Thread and radius templates, camera and spotting attachments, fine motion focus, variable magnification available.
- If you have a special measuring problem, our staff of representatives will be happy to consult with you. The service and engineering facilities of the manufacturer are always immediately available to help you.

Write for Bulletin 147-56

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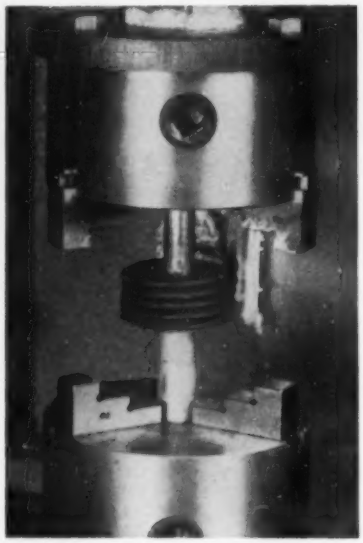
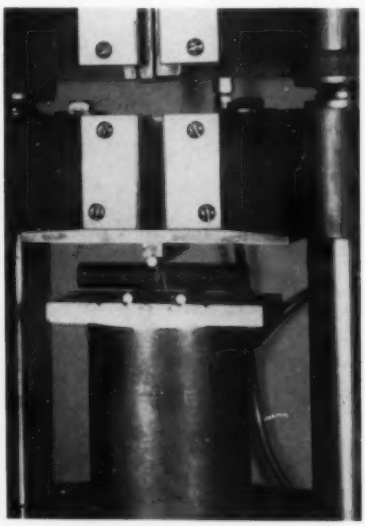


Chucking arrangement for the bonding of the parts. The lower chuck is bolted to press frame for rigidity.

and steel. In developing our Plymet alloy, we have, thus far, had the most successful results with alloys having a very low coefficient of expansion. Thus, as you have probably by now surmised, our powder mixture is such that after diffusion has taken place during bonding, a low expansion iron-nickel alloy similar to Invar results. Certain additives promote rapid diffusion. This rapid diffusion must take place to obtain a strong joint. With many steel shanks, the assembly is cooled quickly without cracking of the carbide. In fact, it is advocated that the tool be oil-quenched upon completion of bonding.

In addition to powder metallurgy core rods and punches, field tests are currently being run on blanking punches for nuts, bottle caps, and similar applications. Plymet buttons are available for trial in tool tipping for turning tools, carbide tipped drills, reamers, and other severe applications. Experiments are in progress on bonding carbide to stainless steel, stellite to steel, and other materials.



Two steel shanks bonded to a thin carbide disk and located in a fixture to measure transverse rupture.

Based on a paper presented at the Metal Powder Industries Federation, 130 W. 42nd St., New York 36, N. Y.

▼ ▼ ▼

The High Cost of Goofing

By Bernard I. Raysor

Harrison Radiator Div.
General Motors Corp.
West Rockport, N. Y.

All of us recognize that quality control, in itself, controls nothing, but is a means of communicating and pointing up conditions, good or bad, in a factual manner. In all instances, the information provided requires human action. An axiom that I think points this up very well is:

To look is one thing
To see what you look at is another
To understand what you see is a third
To learn from what you understand is still something else
But to act on what you learn is all that really matters.

All of us have, I am sure, at one time or another defended our goofs with "it was only a small error—it is less than one percent—man, what do they expect—to err is human, to forgive is divine." This attitude seems reasonable to us in light of the fact that all through our youth we were permitted to goof and perform our school work and receive passing grades at 75 percent or even less. We were on the honor roll if we exceeded 90 percent. Some of us may have been fortunate enough to go to college where we continued to be measured by the same yardstick. Many of us went out into the world to work and seek our fortune with this school attitude, and all of a sudden we were violently awakened to the fact that in industry we are now expected to produce 100 percent of the rates established for the operation, 100 percent quality workmanship, 100 percent safety, 100 percent this, 100 percent that. With our early training and attitude, is it any wonder that as a customer occasionally we find someone has

goofed on the products we buy. Can the high cost of goofing be ignored?

The warranty expense being paid by industry today will answer this for you very quickly. Wouldn't a dime or a dollar spent in warranty repair have been much better spent in preventive action prior to shipment to the customer? The money spent in the plant has not cost the manufacturer his good quality reputation which is almost unsalvagable and for which there can be other serious monetary losses, a a matter of fact, the loss of the business as a whole.

The quality of products produced by a manufacturing concern depends to a large extent upon the quality attitude of all employees and their sincere desire to do the job right the first time. Recognizing that this is so, it is to the best interest of any concern to develop to the fullest a proper quality attitude on the part of all its employees. This is where the quality control people can do a great deal more to help stimulate quality interest.

Based on a talk presented at the Second National Automotive Div. Conference of the American Society for Quality Control, 161 W. Wisconsin Ave., Milwaukee 3, Wis.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Human Relations and the Industrial Order

By Dr. Charles Malik

President, General Assembly
United Nations
New York, N. Y.

The special conditions which the economic world faces so far as human relations are concerned include: (a) the general enlightenment of the masses consequent upon the spread of democracy and its attendant processes of education and mass information resulting in the revolutionary concept of human rights and therefore of the equality of all men; (b) the tremendous revolution in science and technology whereby economic productivity is multiplying a thousandfold and therefore the creation of wealth virtually knows no limits today; (c) the existence of a militant and successful movement preaching the doctrine of the eternal class struggle; (d) the rise of the underdeveloped peoples of Asia, Africa and Latin America who can no longer passively acquiesce in their external exploitation and who therefore vigorously demand an equitable share in any economic association they may enter into with the more developed countries; (e) a general breakdown in morals and standards whereby people think you can manage to get away with it, is all right; and (f) the haunting fear of war leading to profound nervousness and anxiety.

Democracy, science, Communism, the awakened underdeveloped peoples, the general breakdown in morals, and the fear of war—these are the six new factors which complicate the problem of human relations in the economic sphere, and indeed in any sphere, beyond anything known in the past.

Democracy makes people adamant about what they consider their minimum economic rights. Just being human makes one feel that he is just as good as the other fellow and therefore is just as much entitled to material enjoyment as he is. An absolute economic law results which can be expressed in two propositions: (a) in a democracy the standard of living of the masses necessarily always rises; and (b) to avert trouble this possibility of the constant rise of the standard of living of the masses must always be clearly open.

Based on a talk presented at the Mid Winter Personnel Conference of the American Management Association, 1515 Broadway, New York 36, N. Y.

▼ ▼ ▼

Seals: The Vulnerable Giants

By C. E. Hamlin

Autonetics Div.
North American Aviation, Inc.
Los Angeles, Calif.

The high temperature sealing abilities of the elastomeric O ring can be greatly enhanced by the judicious choice of

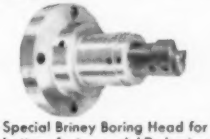
Briney Precision Boring Heads Permit

ADJUSTMENTS TO TENTHS IN A FEW SECONDS

No loosening or tightening of any screws required. Just rotate a graduated adjusting collar with a spanner wrench

BRINEY

SIZE-POSITIVE BORING HEADS are also designed for special boring applications. Some examples



● Special Briney Boring Head for bottom facing and I.D boring with precision depth and bore control.

● Special Briney Head for automatic retraction and feed out.
● Miniaturized heads for cluster boring.
● Block-type tooling for precision boring and O.D. turning used on vertical or horizonal bed multi-purpose machines.

NOW, the patented Briney Principle incorporated into a new precision boring head design and construction gives you all-around savings never before possible. Initial set-up time is drastically reduced and only a few seconds is required to adjust a Briney head for operational tool wear. Scrappage is minimized.

The head is of built-up construction on pre-loaded balls to offer extreme tool rigidity, long life, easy and economical bar replacement. There are no parts to wear that could result in sloppy fits and difficult tool wear adjusting control after extended use. On the job tests indicate balls act as vibration dampeners and eliminate chatter. Fine finishes are obtainable to eliminate many secondary operations.

Size-positive adjustments permit precision control over bore sizes. Very slight bar offset permits speeds up to 9000 rpm, minimizing out-of-balance operation. Manufactured from high quality tool steels and finish ground all over for balance controlling purposes. Every head, special or standard, is individually calibrated after assembly to assure size-positive adjusting control.

Six standard styles to fit most boring applications available off-the-shelf for quick delivery at prices you normally pay for ordinary boring heads.

WRITE TODAY FOR CATALOG and see for yourself the savings you can realize from using Briney Precision Boring Heads

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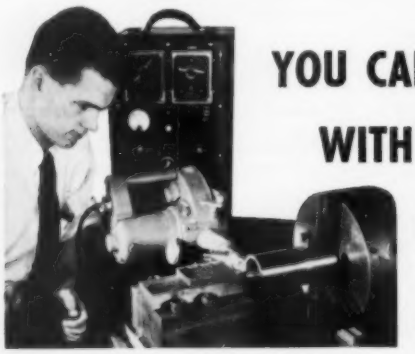
back up ring configuration and groove design. Diametral clearances must be kept to a practical minimum.

Metallic seals for dynamic applications are still in the developmental stage. However, as a class, they appear to have the greatest potential for the sealing in pressures in extreme temperature environments. In areas subjected to nuclear irradiation, metal seals may well be an absolute necessity. In the design of metal seals, investigations to determine optimum material combinations, surface finishes, and relative hardness of rubbing surfaces seems to be of paramount importance.

Perhaps our best opportunity to subdue the previously mentioned "giant" killers lies in the development of truly reliable metallic seals. Therefore, full scale development and evaluation programs appear to be justified.

Based on a paper presented at the National Aeronautic Meeting of the Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.



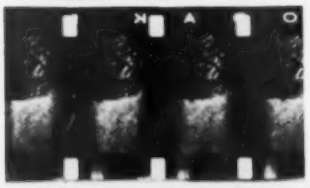
YOU CAN SEE **WHY** WITH **FASTAX**

PROBLEM: *Differences in power consumption, chip formation and tool life when machining Titanium and steel.*

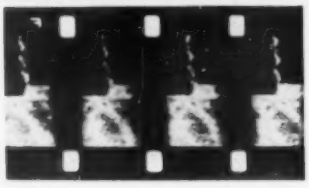
SOLUTION: *A high speed motion picture study of chip formation process of SAE 1020 and SAE 1112 steel being machined under same conditions as Titanium.*

1: FASTAX High Speed Camera taking movies at 7,500 frames per second through a microscope. Actual frames from movies shown below.

2: SAE 1020 steel. Large built-up edge at cutting speed causes poor surface finish. Shear angle is low, resulting in very thick chip and consumption of considerable power in removing metal.



3: SAE 1112 steel. Built-up edge is absent due to lower friction on tool face . . . improved surface finish. Shear angle is higher and chip thinner. Power consumption is lessened.



4: TITANIUM (Ti 150A). No built-up edge. Surface finish is excellent. Shear angle high, but not constant in value. Chip forming process is cyclic. Since thin chip, power consumption is low. Tool life shorter because of metal structure.

This is just another industrial production problem solved through the eye of a FASTAX High Speed Motion Picture Camera—one of 26 different models available for solving *your* problems.

WRITE us your design or production problems. High Speed photography can be the answer. New bulletin available.

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Control of Process Variables for Welding Foil

By John Campbell

Air Reduction Research Lab.

The accelerated activity in the field of high-speed flight has emphasized the need for designs which achieve high structural strengths in low-weight components. The ultimate in achievement can be realized when the joints in these sections possess a strength which approaches theoretical values. Such joints should have the chemical composition of the base metal to resist corrosion and softening at high temperatures. External seams also should be aerodynamically smooth.

The basic nature of the welding process offers a high degree of compatibility with these requirements. The achievements of welding when it has replaced other joining methods are a sound recommendation for its use in this demanding application. The inert-gas-shielded tungsten-arc welding process is a logical choice since weld penetration and reinforcement are more readily controlled by this technique. However, consideration of the nature of the process variables is required for its successful application. Their effect, usually minimal in the welding of heavier sections, exerts a controlling influence on the design and operation of process components. The work covered in this paper discusses these subjects as they were developed in a laboratory investigation of the welding of materials which were 0.002, 0.003 and 0.005 inch in thickness.

Accurate edge preparation is essential to the success of the welding operation. The precision of edge preparation must increase with decreasing material thickness. Various methods of edge preparation are discussed with respect to applicability and probable precision for a given thickness and length of cut.

The volt ampere characteristics of arcs used in the welding of foil necessitate careful consideration in choosing the process components. At these low currents, arc voltage is found to increase very sharply as current decreases. This behavior is also influenced by the shielding gas and operating arc length. Necessary arc stability requires a well-defined intersection of the characteristic curves of the arc and the power supply as well as a specific electrode configuration. The interrelation of these variables is explained so that a workable set of conditions may be established for various material thicknesses.

The contour of the welded joint is affected by arc and surface forces on the molten weld pool. The metal is slightly displaced to either side of the seam by these forces so that a thinner section is usually obtained in a plain

butt joint. Proper design of the holddown and backup strips for a given material thickness is shown to limit this effect. The attainment of theoretical joint efficiency with controlled reinforcement is made possible by the careful addition of filler metal to the joints. Methods of making this addition are discussed with respect to particular applications.

Based on a paper presented at AWS 40th Annual Meeting and AIEE Electric Welding Conference. Obtain copies from the American Welding Society, 29 W. 39th St., New York 18, N. Y.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Control in the Molding Process

By Gordon B. Lankton

E. I. duPont deNemours & Co., Inc.
Wilmington, Del.

The pattern of polymer flow in the mold has long been known to be an effect of size, sharp, and cross section of runner, type and size of gate, and cavity layout. Extensive study of each of these design features has been made in relation to nearly every type of thermoplastic resin.

There are rules of thumb of mold design for use with each resin. For instance, because of the higher relative viscosity of acrylics, runners of a mold designed for acrylics should have a greater cross-sectional area than those designed for nylon. A rule of thumb on gate design is that the gate land should be one-half of the gate diameter. Another rule is that runners should be decreased in cross section after each right angle turn from the sprue to the cavity in order to build up pressure. Many mold designers design a multicavity mold in the so-called balanced fashion, with gate sizes proportional to the distance of the cavity from the sprue; other mold designers do just the opposite and make the gates farthest from the sprue proportionately smaller.

There still remains a great deal to learn about mold design before we can accurately predict the exact fill pattern of the mold while it is still on the drawing boards. Even today the majority of molds constructed must be sent back for alterations after a trial run since preliminary designs are seldom completely satisfactory.

It is frequently assumed that nonuniform filling of the mold is due solely to mold design. This is not generally the case. Molding conditions, especially those affecting the rate of polymer flow into the mold, have an important effect on the pattern of filling. With an understanding of the effect of molding conditions on mold filling, the molder can often accomplish what would otherwise require design changes to the mold.

A particular filling pattern is a function not solely of mold design but also of molding conditions. A mold designed to fill uniformly at specific molding condition may fill very nonuniformly at other molding conditions. Conversely a mold which has an erratic filling pattern may not need to have gate and runner sizes altered; it may fill very uniformly at other molding conditions that are well within the molding limits for the particular job. To carry this further, it may be desired to convert a mold designed for one thermoplastic resin to use with another very different thermoplastic resin. If the effort of molding conditions on filling pattern is understood and applied, it may be possible to get a uniform filling pattern

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without altering the mold.

When is this important?

It is important on dimensions. If one section of the cavity fills faster than another section, there will be differences in pressures in the cavity, in rates of setup and solidification, and in internal stresses. These factors all affect shrinkage and consequently dimensional tolerance.

It is important on surface finish. If some cavities in a multicavity mold fill earlier with resin of higher temperature, the surface finish of the pieces from these cavities will differ from that of the pieces from the cavities that filled later.

It is important in weld-line formation. Weld lines form when the resin stream is divided into two fronts which subsequently meet and weld together in a weak bond. The pattern of filling can often change the position of the weld line to a less critical place; sometimes eliminate it.

Based on a paper presented at the Regional Technical Conference of The Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

Improving Management Efficiency

By Wilford L. White

Director
Office of Management and Research Assistance
Small Business Administration
Washington, D. C.

To improve management efficiency, three ideas are:

1. Establish policies and procedures for the business
2. Distinguish between operation and administration and allocate some time every week to administration
3. Learn to look outside personal experience for aid in solving management problems.

Based on a talk presented before the Small Business Conference on Management Problems at Roosevelt University, Chicago, Ill.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Industrial Engineering in Maintenance

By J. U. Saum

Manager
Controls Branch
Bureau of Yards and Docks
Navy Dept.
Washington, D. C.

Industrial engineering is going to have to be cranked into maintenance engineering if we expect top management to listen to us. As long as the maintenance engineer, or the maintenance manager, persists in perpetuating "seat of the pants" management for maintenance—he can't expect the more enlightened top management to pay much attention to him.

Industrial engineering principles and techniques can be—and have been—cranked into maintenance. But, in most instances, you should not expect the same accuracy and rigid control in maintenance that you achieve in production.

You should start out with the more fundamental industrial engineering techniques. They are easier to adapt, and the payoff comes faster. You first must have a basic management system as the framework for applying the principles and techniques of more advanced industrial engineering. However, you're going to have to explore the more sophisticated techniques of industrial engineering if you expect to get full value for your maintenance dollar.

Based on a paper presented at the Plant Maintenance & Engineering Conference by Clapp & Poliak, Inc., New York.

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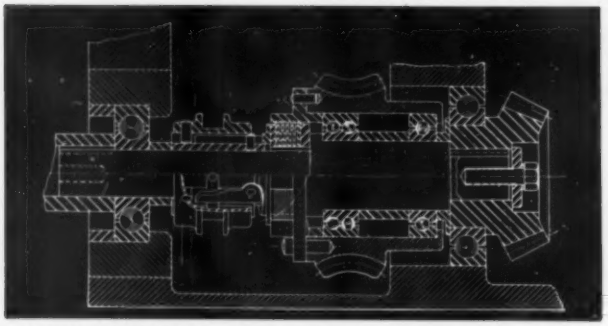

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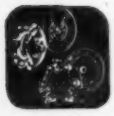

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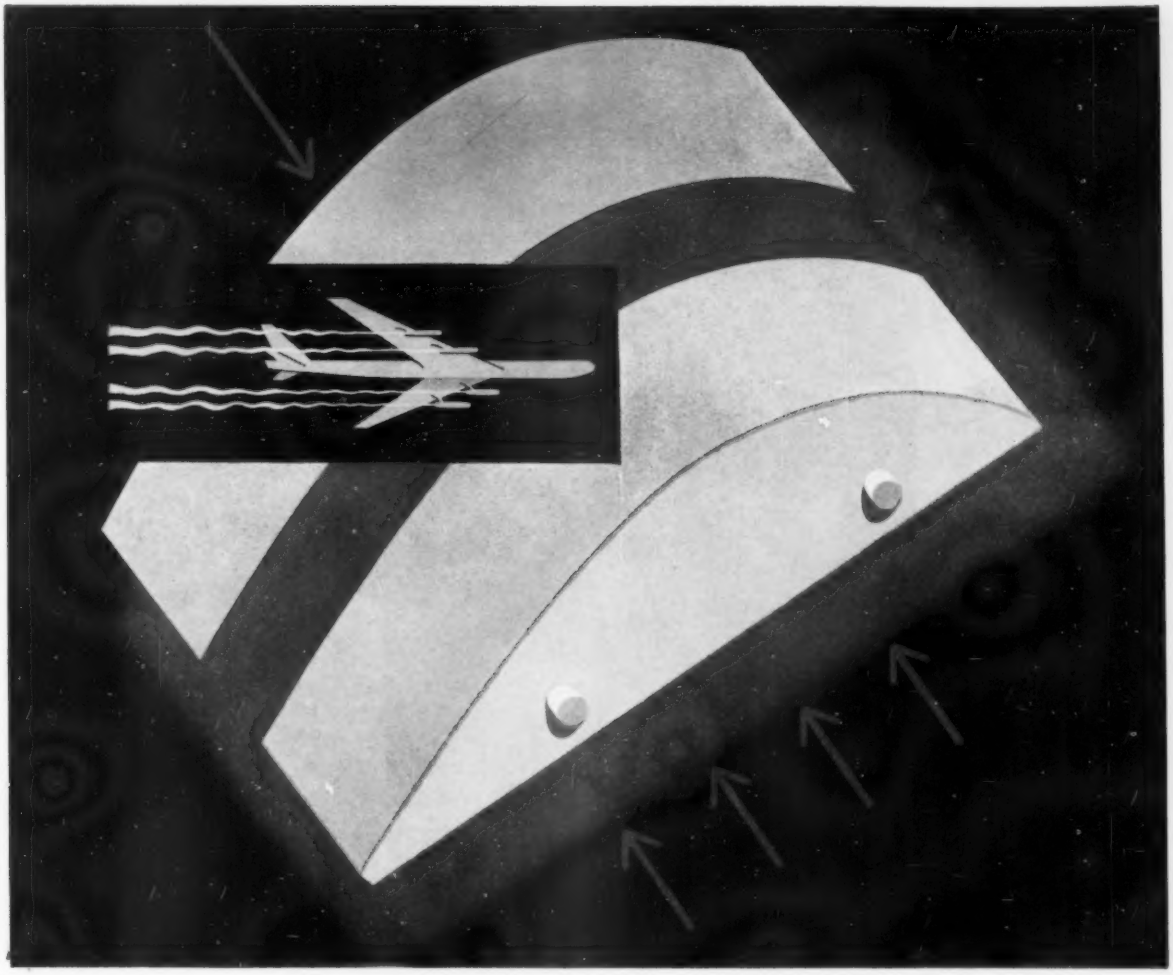

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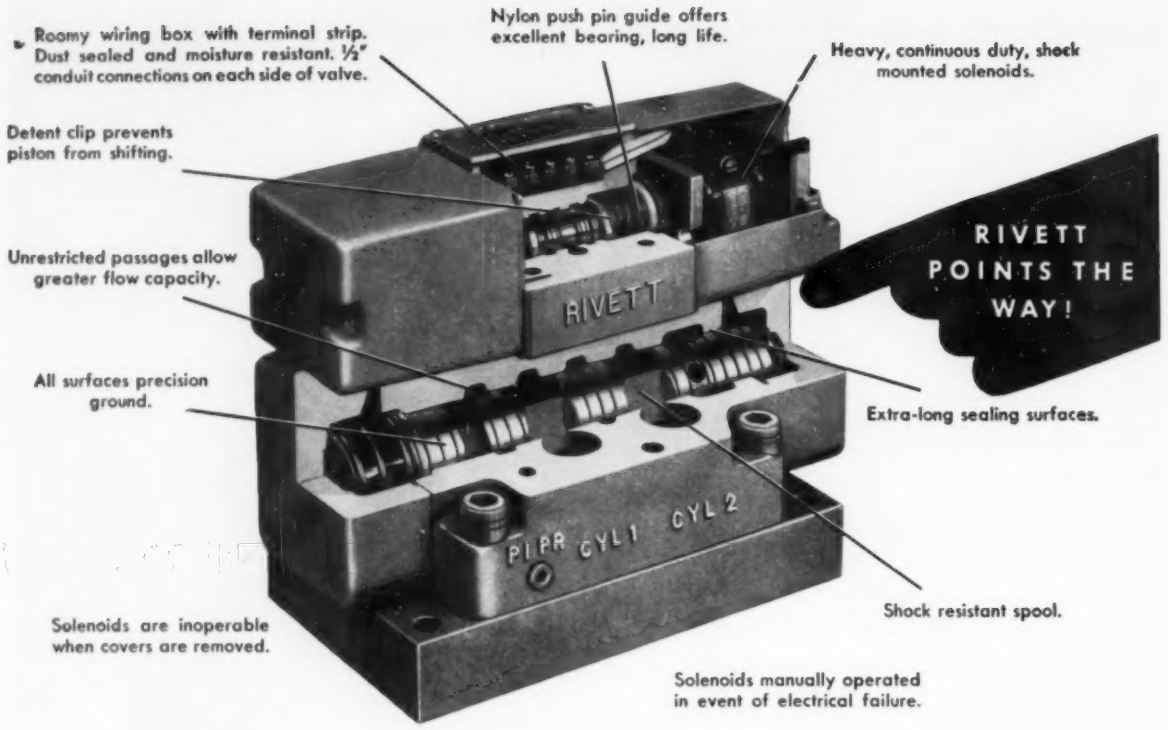
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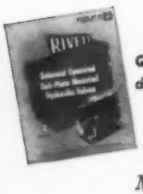

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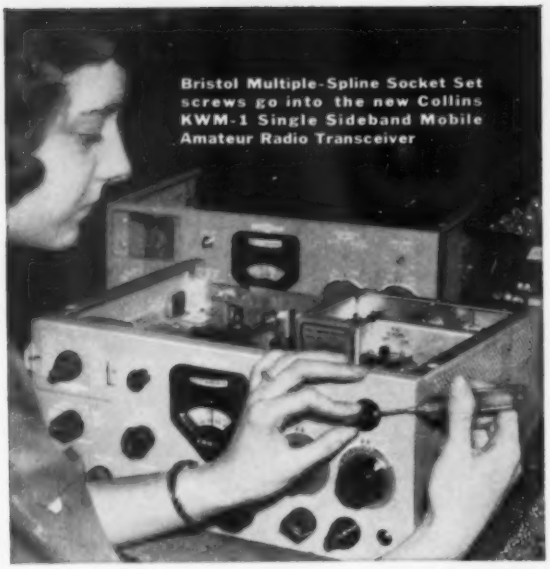
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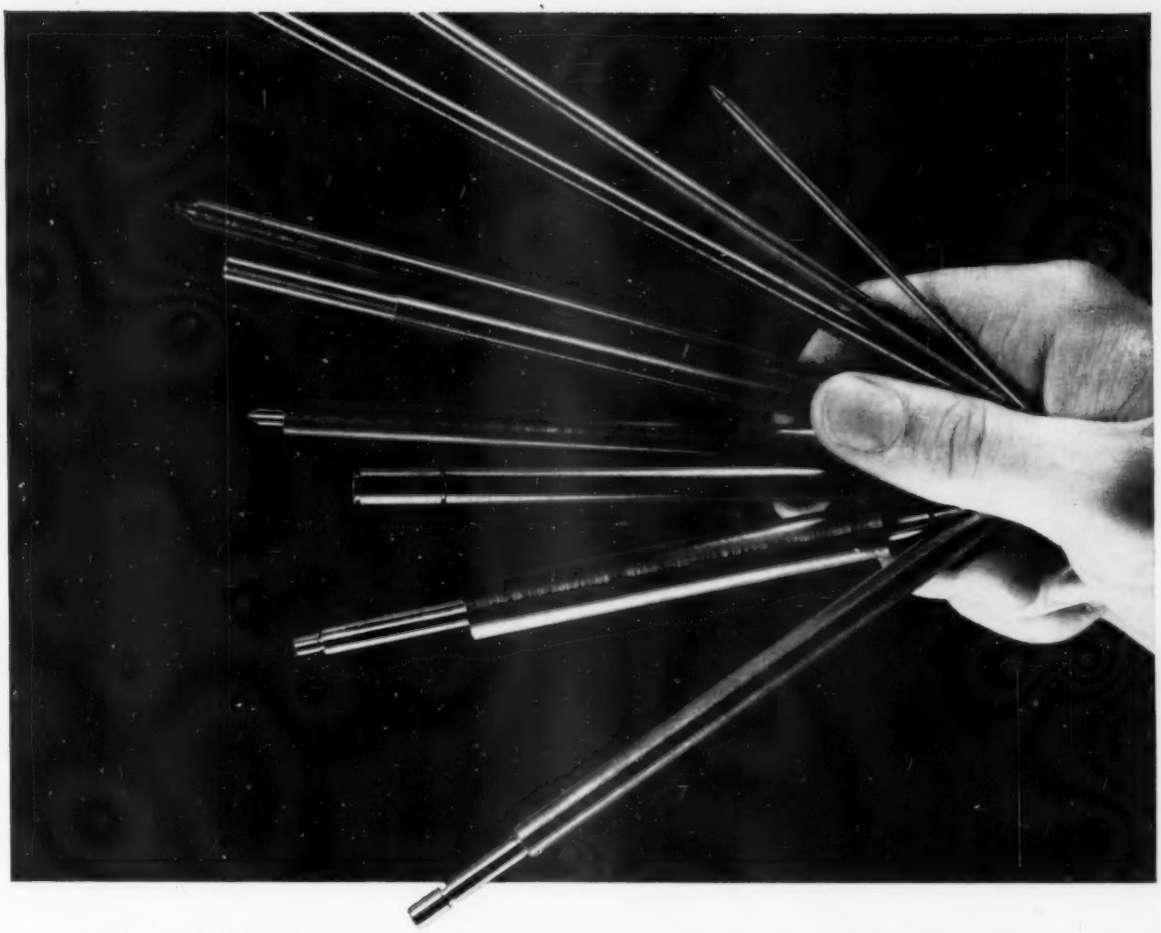

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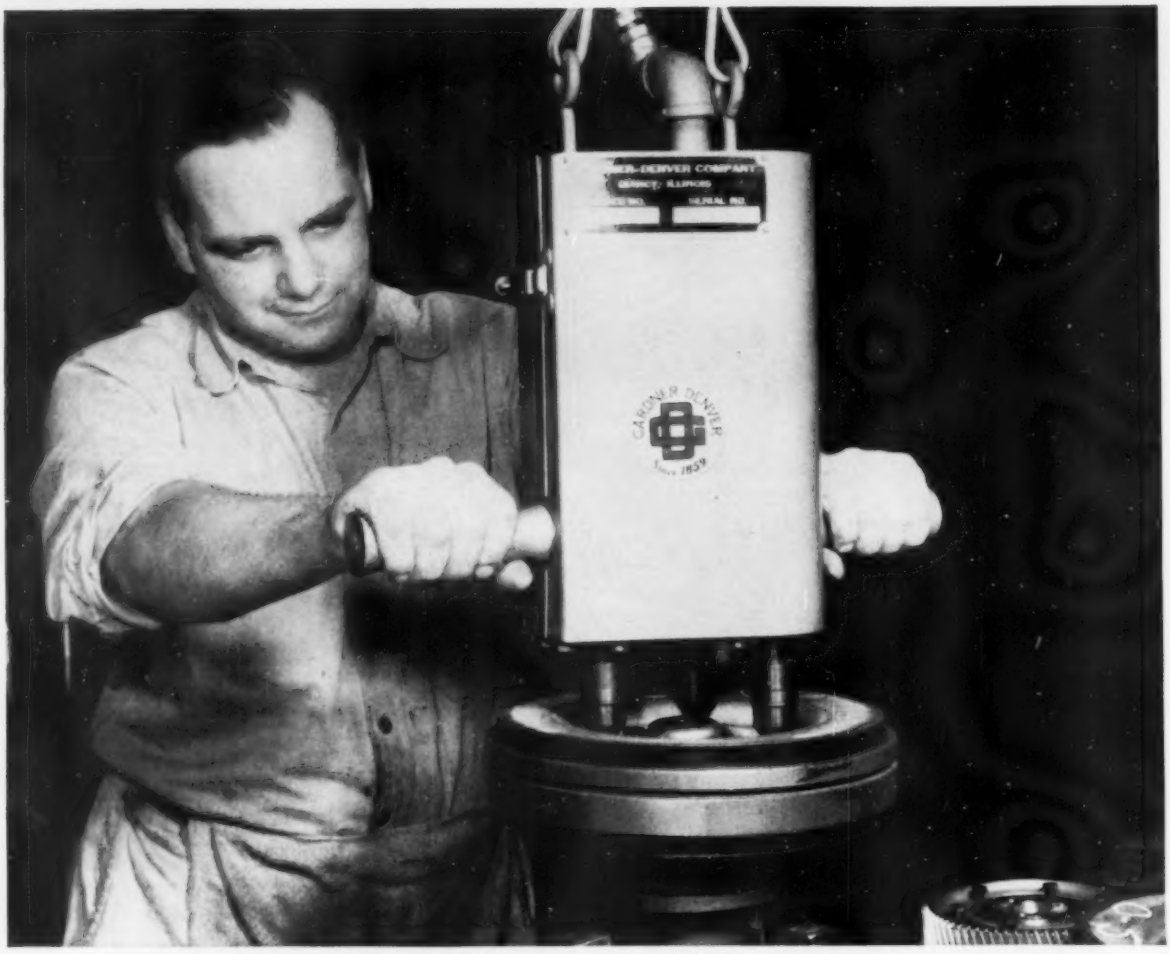

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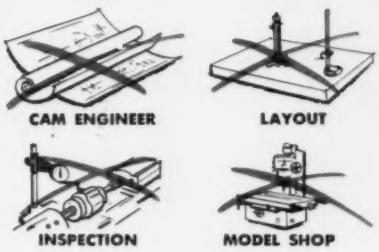

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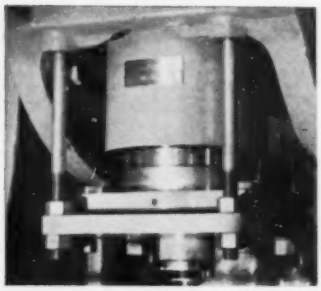

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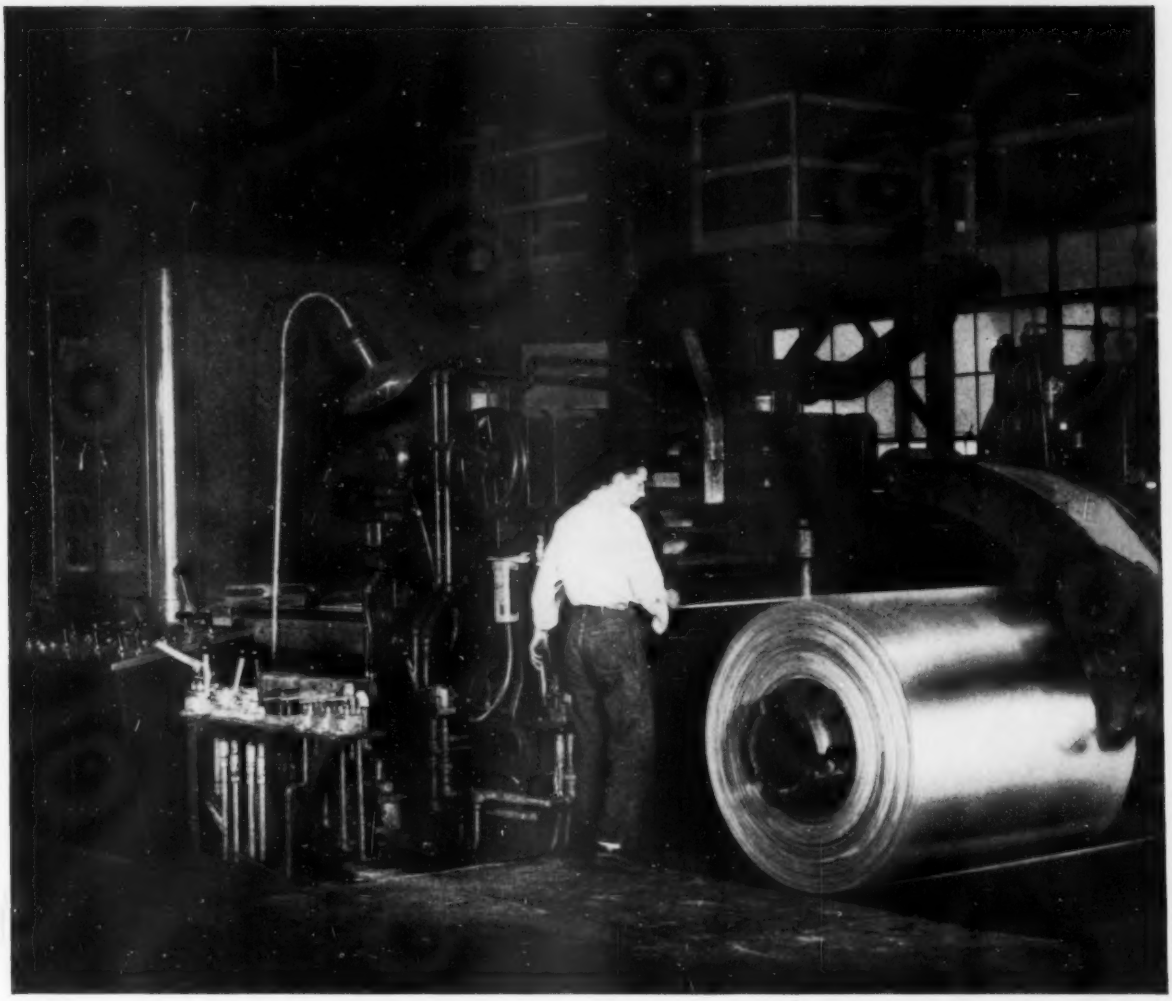

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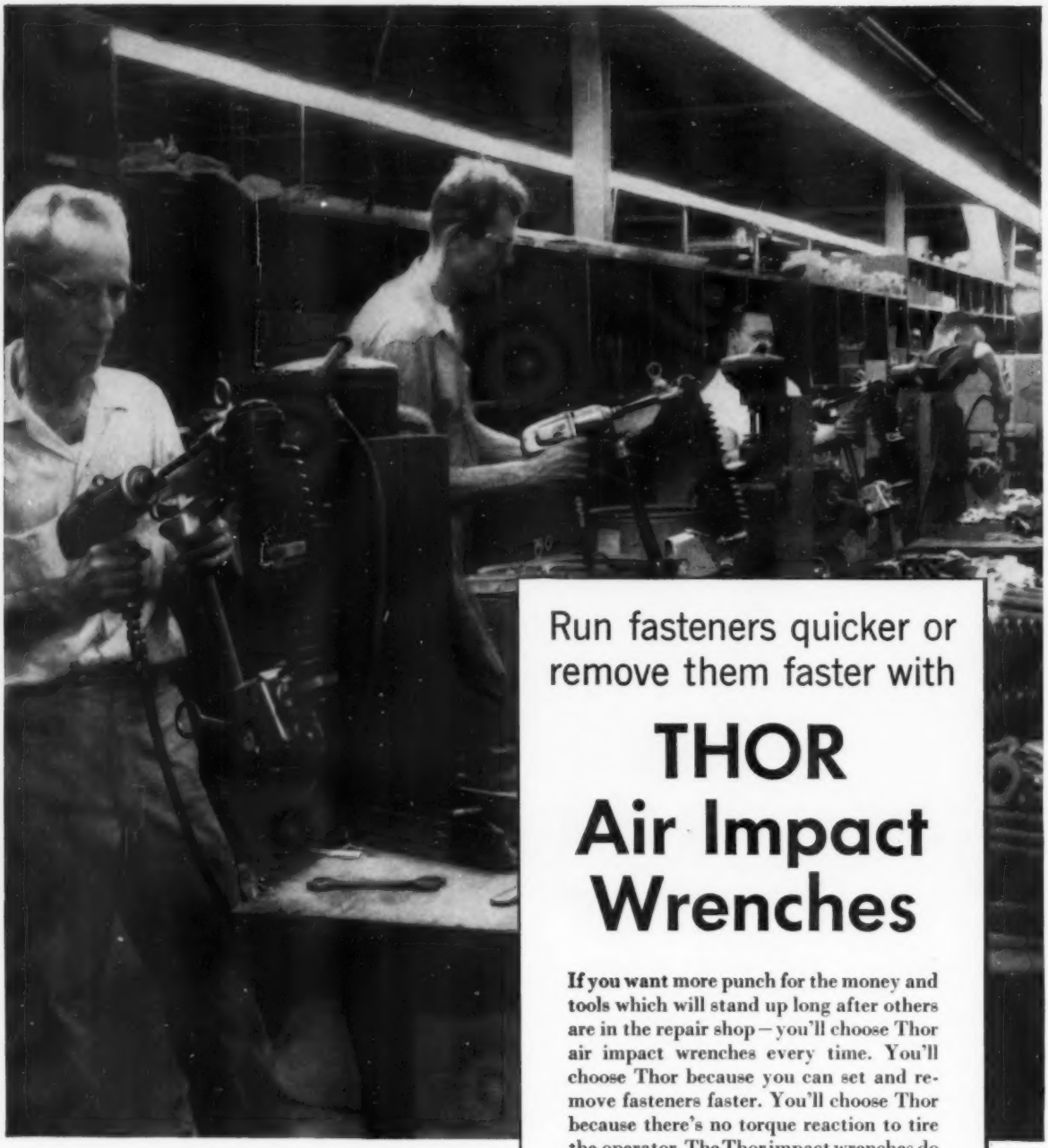

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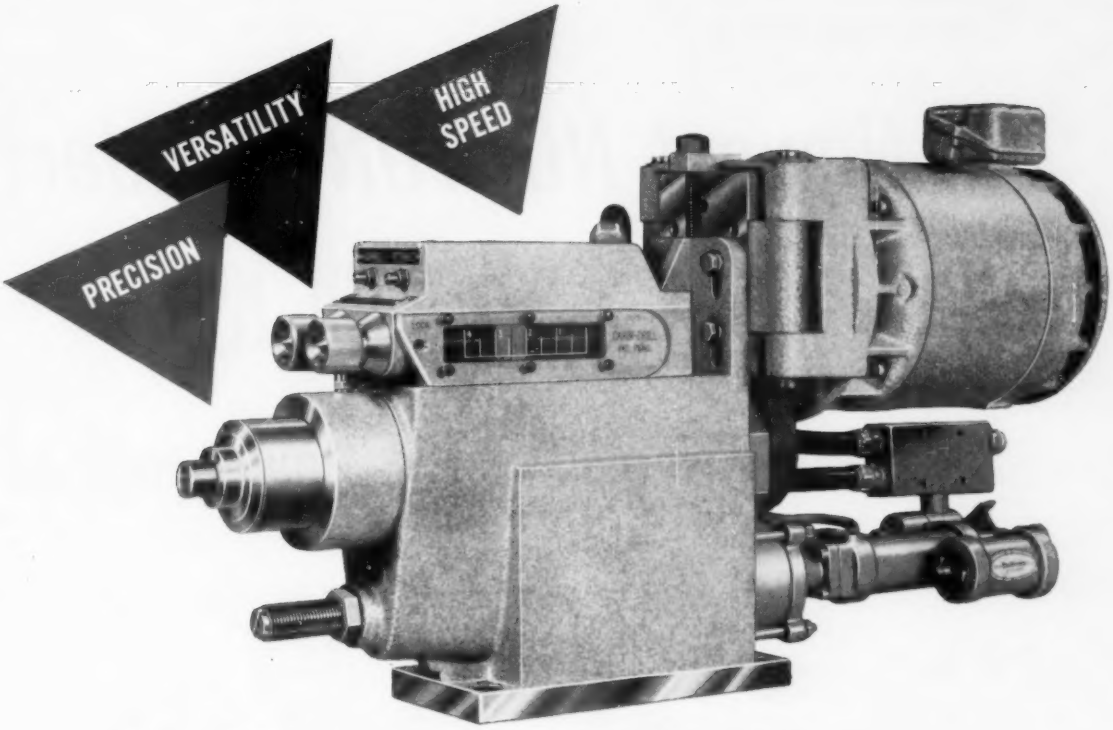


are a few of the outstanding features of the

BELLOWS "Carbi-Drill" DRILL UNIT

- Capacity up to 5/8" diameter drill in mild steel.
- Runout will not exceed .001" T.I.R. in full 4" stroke.
- Depth accuracy .003" with standard limit switch; .001" with optional Bellows BT-1 Timed Dwell Control.
- Stroke adjustable from 1½" to 4", with optional stops to permit shorter stroke lengths. Thrust is equal to 10 times applied air pressure.
- Spindle speeds available from 609 RPM to 6275 RPM.

This rugged, heavy-duty drill unit is ideal for tool-room built special purpose machinery for drilling, tapping, reaming, counterboring, etc. It can be mounted in any position. Units can be easily synchronized electrically with each other or with other Bellows "Controlled-Air-Power" devices for fully automatic operation. Air-powered rapid advance, controlled hydraulic feed rate, air-powered rapid retract provide maximum speed with feed rate adjustable for any tool working in any material.

Take a quick rundown of the main features of this versatile "CARBI-DRILL" unit, then write for a copy of Bulletin CD-17, which gives complete details. Address Dept. TE-859, The Bellows Co., Akron 9, Ohio. In Canada, Bellows Pneumatic Devices of Canada, Ltd., Toronto 18.

1325-B

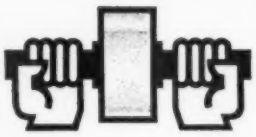
The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

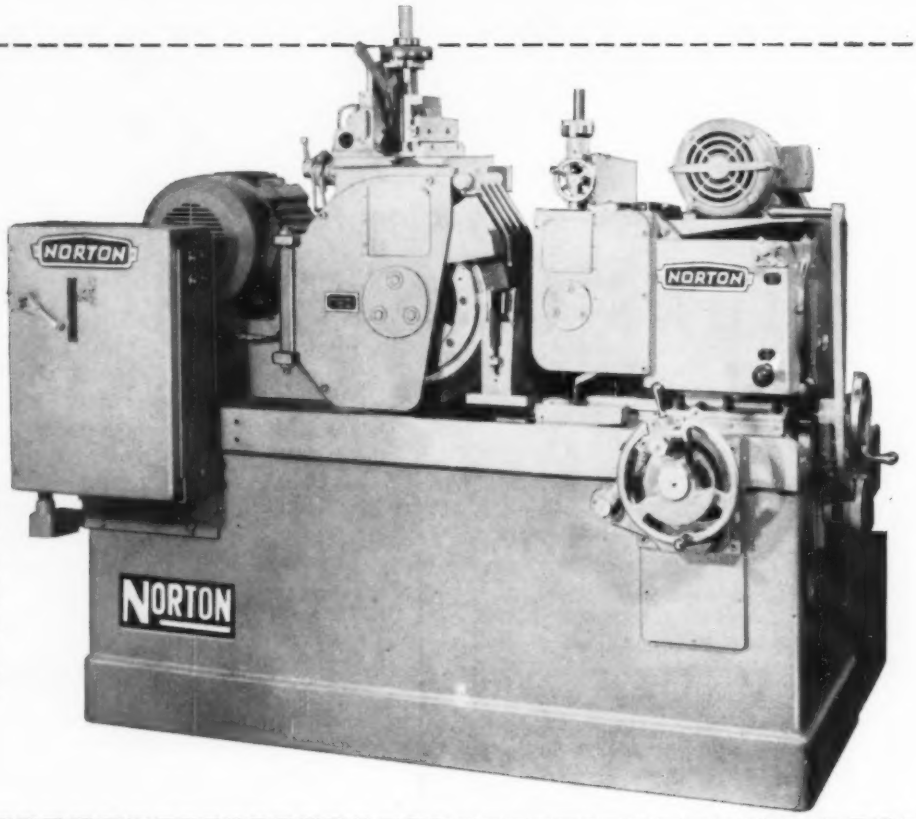
AKRON 9, OHIO

Newest NORTON Grinder!

The No. 2 Straddle-Bearing

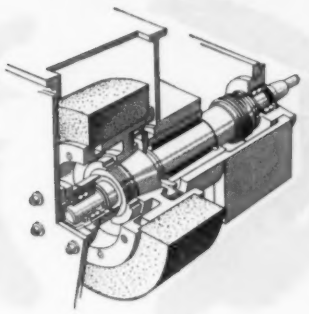


Centerless is built for speed . . .



Ready for Immediate Delivery
The new Norton No. 2 Centerless Grinder can be arranged for full automatic, semi-automatic or manual thru-feed or plunge grinding. Capacity includes work diameters ranging from 1/16" to 4¾" depending on type of work rest and bar grinding fixture.

3 MAJOR ADVANCEMENTS IN CENTERLESS GRINDING



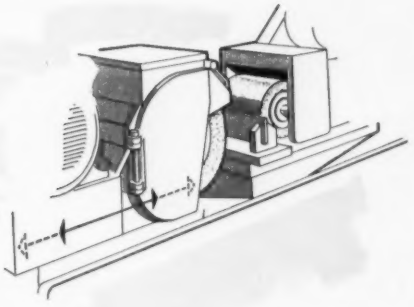
accuracy . . . economy

Straddle-Bearing Spindle Support, in both grinding and regulating wheels, provides extra strength. Combined with the inherent rigidity of Norton spindles this boosts capacity to take heaviest cutting pressures, while permitting fast grinding to close tolerances under all conditions.

Like all Norton grinders and lappers the Norton No. 2 *Straddle-Bearing* Centerless Grinder is built to deliver "Touch of Gold" performance — the Norton extra that adds value to your product while cutting your production costs.

You'll find plenty of proof of that in the modern construction of this newest machine of its type. *Straddle* support of spindle bearings adds strength and ability to take tough jobs . . . the mobile wheel head and constant work-loading alignment make jobs shorter and easier.

Many other features result in outstanding performance advantages. Call your Norton Sales Engineer, a trained expert in the grinding field, for consultation on how these features can benefit your production. Or write for Catalog 1328. NORTON COMPANY, Machine Division, Worcester 6, Mass.

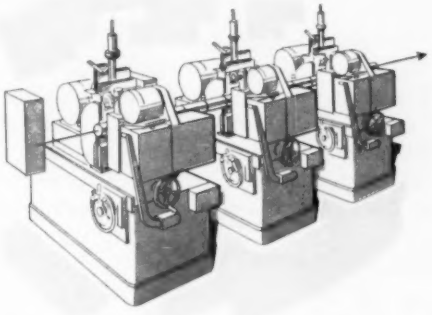


Mobile Grinding Wheel Head, with wheel mounted between head ways and feed screw located beneath wheel center for ideal balance, provides instant response to signals. This results in especially fast sizing, one of many important advantages over fixed head operation.

NORTON

GRINDERS and LAPPERS

District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit.
In Canada: J. H. Ryder Machinery Co. Ltd., Toronto 5.



Work Loading Alignment is never disturbed by wear of either grinding or regulating wheel . . . neither is the alignment of the work rest blade. Movable heads for both grinding and regulating wheels make this advantage possible . . . and especially time-saving in a battery set-up.

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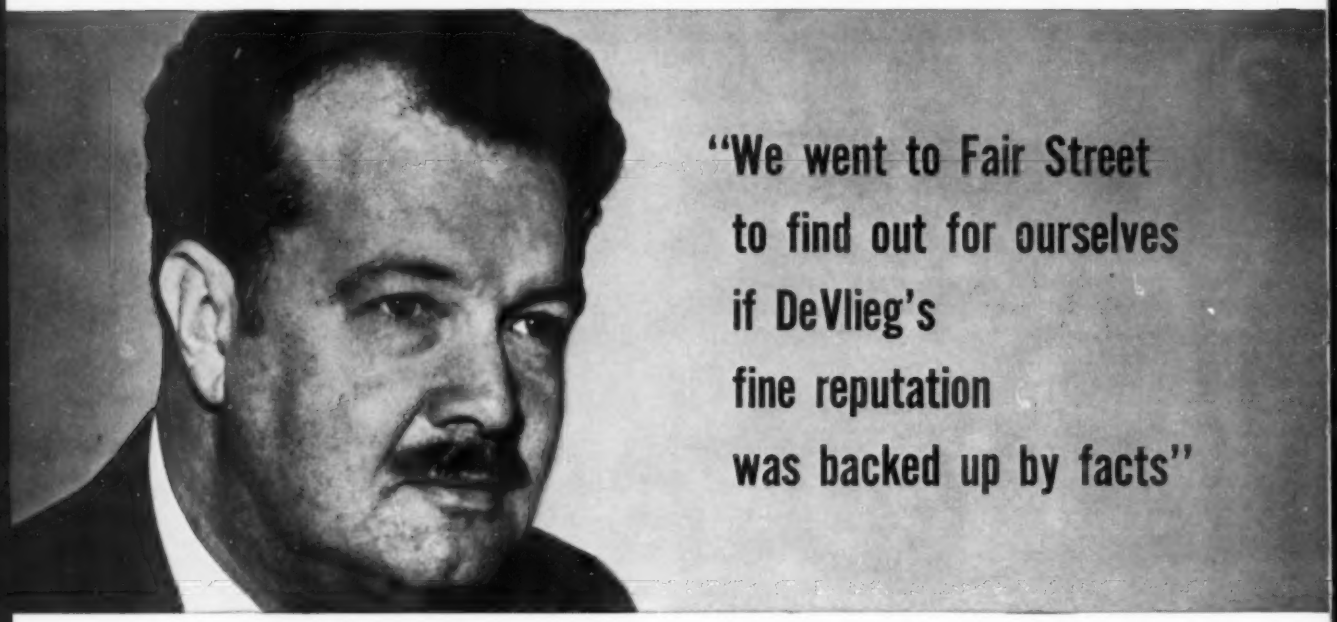
GUSTAV VON REIS, President
Detroit Broach & Machine Co.

a man who came to Fair Street



"We were convinced. We purchased two JIGMILS and they have now been in operation for several years. These machines have all the fundamentals required to produce the highest degree of accuracy, and yet, are simple to operate. Besides this, and we feel most important of all, the JIGMIL has special features which largely eliminate our reliance on the human element to produce close tolerance work. JIGMILS enable us to produce our broaching machines and broaching tools to the very highest degree of accuracy, a matter of the utmost importance in our products."

GUSTAV VON REIS

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Apex Corp.
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Jameson Machine Co.
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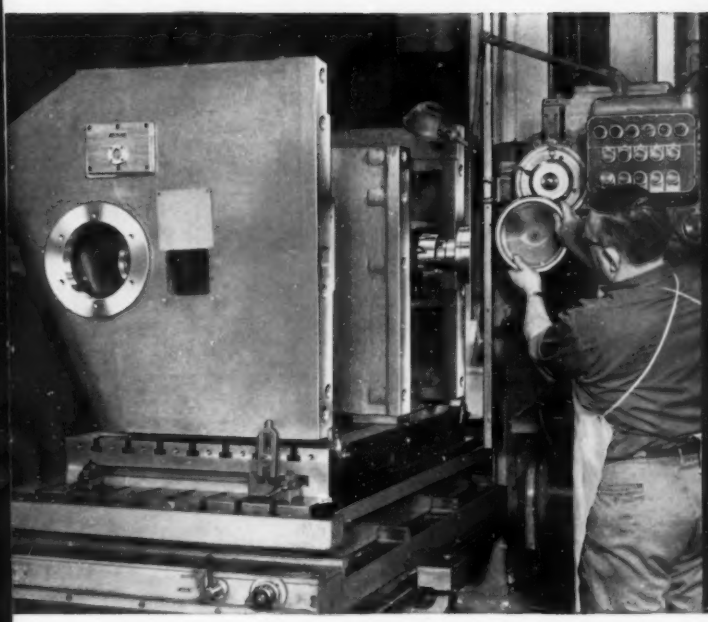

A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- Increases production and product accuracy.

ACCURACY IS AN ECONOMY!

JIGMIL—EXTREME ACCURACY ON LARGE, WEIGHTY PARTS FOR DETROIT BROACH

Broaching machine knee, 65" long, weight 5500 lbs., set-up on a 32" x 60" index table on a Model 4B-72 JIGMIL. The knee is rough and finish milled, bored, drilled and tapped from four sides in one set-up. Formerly machined on a conventional boring mill, the job took 120 hours. The JIGMIL now completes all machining operations in 50 hours with consistent accuracy and without special tooling. Furthermore, the accuracy achieved effects substantial reductions in assembly time and improves the quality of the end product.

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Mark Twain Tool & Mfg. Co.
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ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

USE READER SERVICE CARD, CIRCLE 86

New Sundstrand Multiple Spindle Drilling and Boring Machine Offers Precision at Low Cost

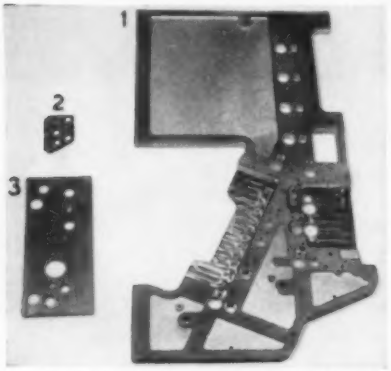
Sundstrand's new precision drilling, boring reaming and tapping machines, permit higher accuracies and lower costs in producing large numbers of holes on relatively complex parts. Unique design of the work heads eliminates all gearing, permitting close center distances, reducing cost of interchangeable work heads, and speeding change-overs.

Two models are available with either an 18 x 36-inch head or a 9 x 14-inch head. Machines are designed primarily for work with nonferrous metal parts.

Complete work heads can be changed in 15 to 20 minutes and additional flexibility for similar parts is offered by equipping heads with spindles that can be fitted quickly with a tool as required.

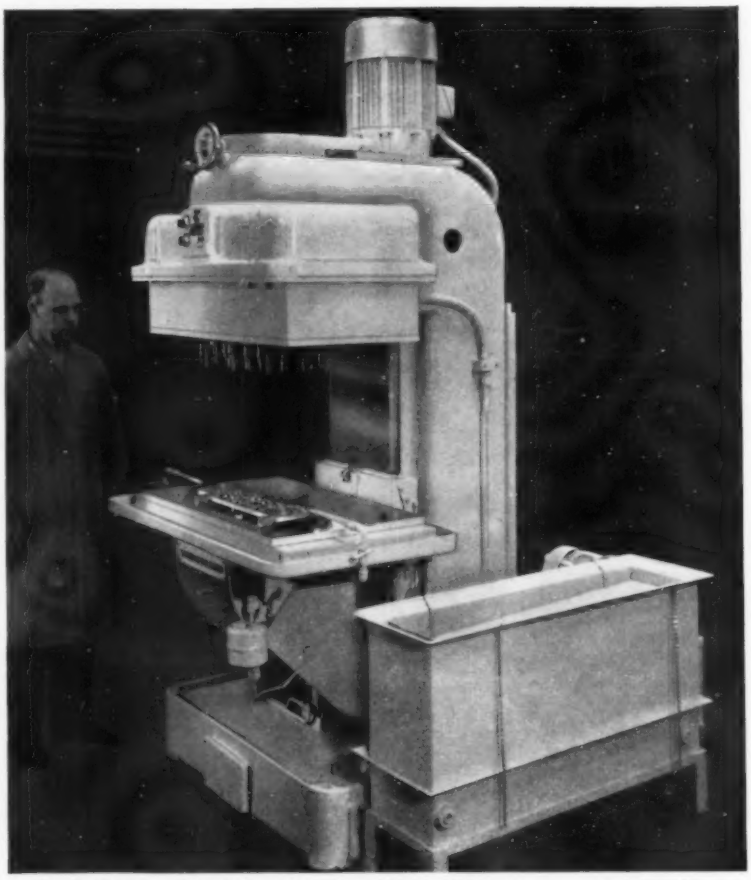
Unique design enables relatively low cost spindles to be used while maintaining the highest standards of accuracy. Furthermore, in the event of a change over in work being handled, approximately 75% of an obsolete head can be salvaged and applied to other jobs.

Highly skilled operators are not required to hold tolerances to .0002 inch for spatial relationship, shoulder depth and hole size — depending on size of part, shrinkage, expansion, material composition, tool maintenance, etc. Inspection requirements are greatly reduced because spatial accuracy is built into the head, fixtures, and machine itself.



Typical parts show wide range of work handled on new multiple spindle machine. Additional data is given in table on facing page.

Following initial inspection of tooling and a check of first parts produced, subsequent parts need only be checked for hole size and shoulder depth. Where spatial relationships are extremely critical occasional spot check is generally all that is required.



New Sundstrand multiple-spindle machine offers precision and simple change over, does not require highly skilled operator.

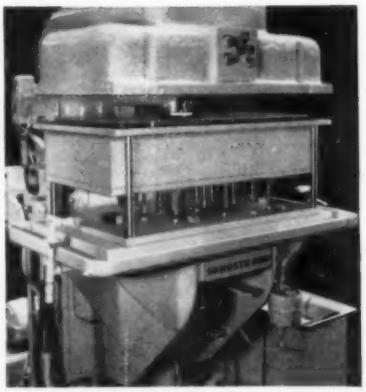


Table is lowered to take new work head in change over then is elevated until coupling on drive spindle mates with machine spindle. Dowels insure accurate alignment, four bolts hold head in place.

Even change-overs take no special operator skills since the head mates with the machine spindle, is located by dowels and is held in place by four bolts. The work-holding fixture is positioned quickly and simply in relation to the work head.

Surface speed at the largest hole being machined with a particular head determines all spindle speeds.

"Engineered Production" Service

SUNDSTRAND

TYPICAL PERFORMANCE DATA

JOB NO. 1 ALUMINUM SIDE PLATE — 32¾" x 17" x ¾". Seven heads are used to drill and chamfer 138 holes and to perform semifinish and finish boring, counterboring, and reaming operations on selected holes. Tolerances in most critical holes are +.0005, −.000 for size and ±.001 for location. Total machine time 4 minutes.

JOB NO. 2 ALUMINUM BEARING PLATE — 2.4" x 3.9". Stamped part has over 30 small holes and four large holes precision bored to +.0002, −.000 for size and ±.0001 for location. Total machine time 7 minutes.

JOB NO. 3 ALUMINUM SIDE PLATE — 12½" x 5" x ¾". Large holes previously rough drilled. All small holes are drilled, critical holes are semifinish bored, 2 holes are counterbored, and in final operation all critical holes are finish bored to +.0005, −.000 for size and ±.001 for location.

This does not impose any limitation on production as no other method will produce an equal number of holes at as low a unit cost and with the same high degree of accuracy.

Feed rates for drilling, rough and semi-finish boring in aluminum and magnesium are .005 to .008 inch per revolution. Finish boring in the same materials is at .0005 to .001 per revolution. Tapping heads can also be provided with the specific details of the application determined after a study of all the variables.

Multi-cycle 25 hp Lathe Announced

Sundstrand's new Model 14T-25 lathe handles three roughing and a finishing cut with a single template in a fully automatic cycle and insures exceptional accuracy of finished work because stylus and cutting tool are closely coupled to reduce deflection and related errors. Setup times are reduced and accuracy is increased by graduated scales provided for dog setting, template positioning, tailstock positioning, and cross facing slide location.

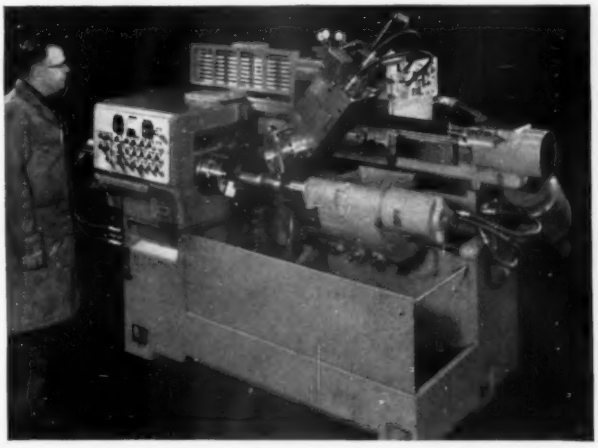
Dial indicators at the top of the tracing carriage permit depth of cut to be set accurately. At the completion of three roughing cuts, the tool turret indexes automatically to take a .020-inch finishing cut.

The Model 14T-25 is designed with the rigidity and spindle speeds required to use carbides for the roughing cuts and ceramic tooling on the finishing cut. Either two or four speed transmission-type heads are considered standard with eight speed heads available on special order.

Work area is readily accessible to simplify loading by operator or addition of automatic workhandling equipment. Sundstrand Model 14T-25 lathes are available with 24, 32, or 40 inches length between centers and offer a maximum turning diameter of 4½ inches. Facing slides with separate feed unit permitting operation at any time during machine cycle are available as optional extras.

Rough forging and finish turned shaft produced on Model 14T-25 lathe. Two setups handle complete part.

Stem pinion forging is turned in two setups with production rate determining whether one or two lathes handle the job.



Newly designed Model 14T-25 Sundstrand tracer lathe provides three roughing and one finishing cycle automatically.

SUNDSTRAND MACHINE TOOL

DIVISION OF SUNDSTRAND CORPORATION

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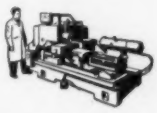
SUNDSTRAND

More facts about

SUNDSTRAND

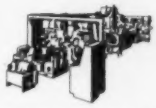
"Engineered Production"

Literature listed under various machine types has more details. Write Sundstrand for your copy today.

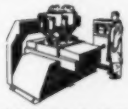


Automatic and Tracer Lathes Bulletin A-706

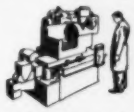
Engineered Milling Production Bulletin B-706



Examples of Transfer Machines—Bulletin C-706



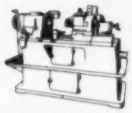
Multiple-spindle Drilling Machines—Bulletin D-706



Internal and Rotary Surface Grinders—Bulletin E-706

Broaching Tools Bulletin F-706

Practical Broaching Methods Bulletin F-706



Thread Milling Bulletin G-706

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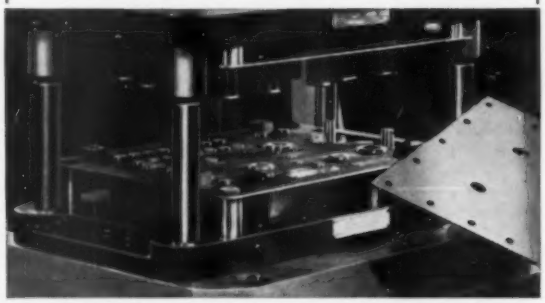

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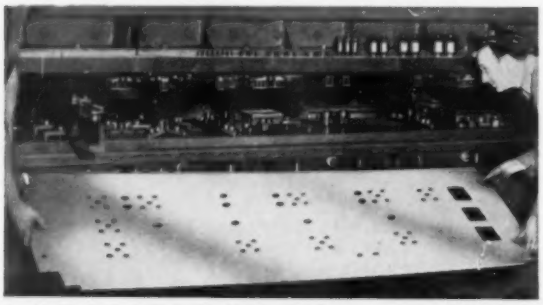

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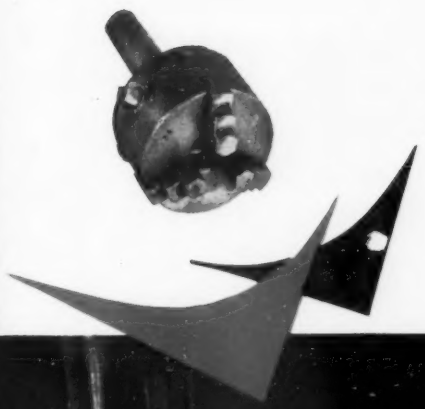
CHUCKING METHODS CAN BECOME OBSOLETE TOO!

retool with **Cushman**

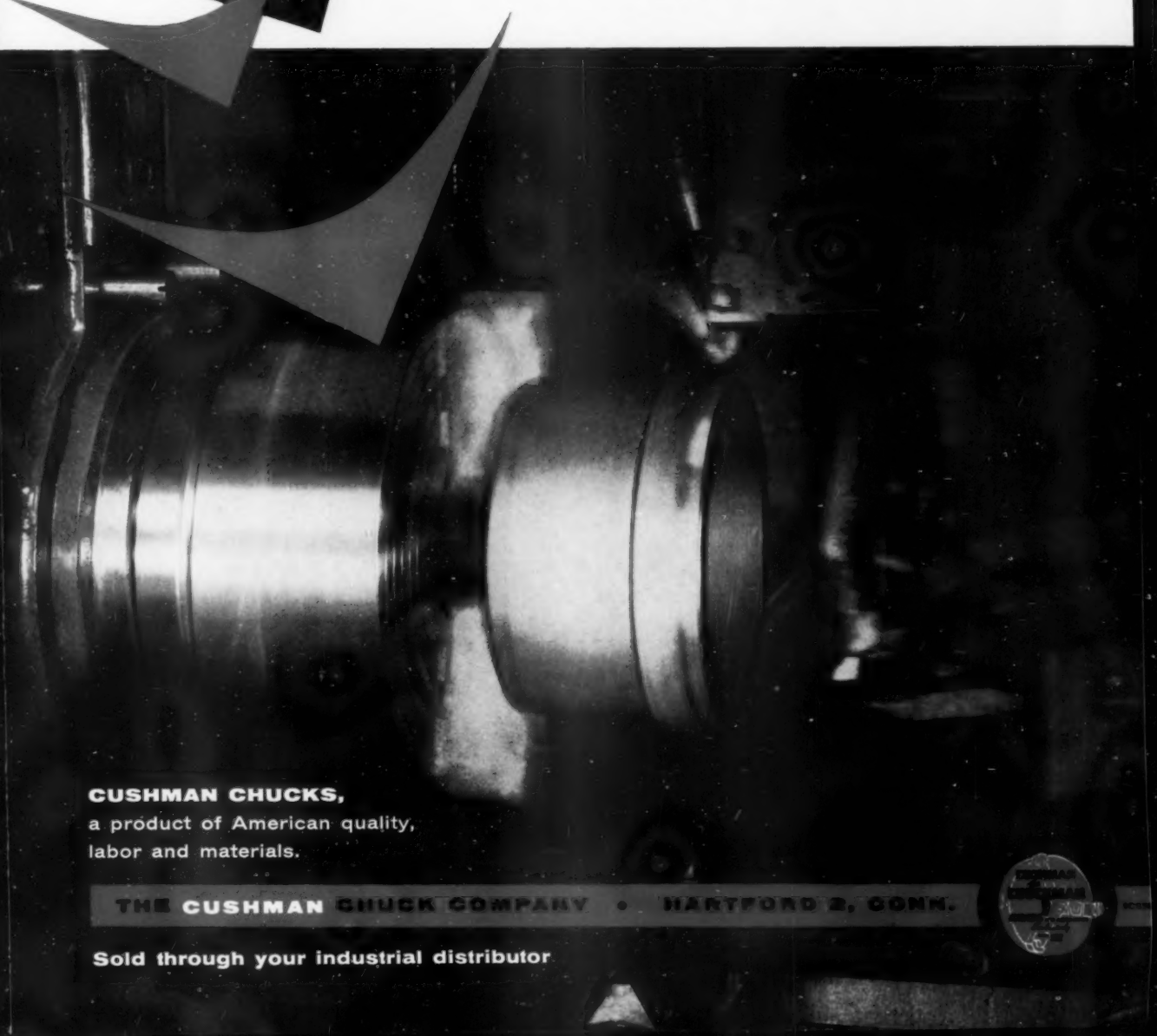
AIR OPERATED CHUCKS



Designed and built to fully meet modern machining techniques and machine tool requirements, Cushman Chucks permit the use of higher speeds with heavier feeds, maintaining closer tolerances with continued repetitive accuracy and result in maximum workholding efficiency with the greatest savings in time and costs.

For profitable machining through the use of precision chucking equipment, specify Cushman Air Operated Chucks.

Write for Bulletin PO-66D.



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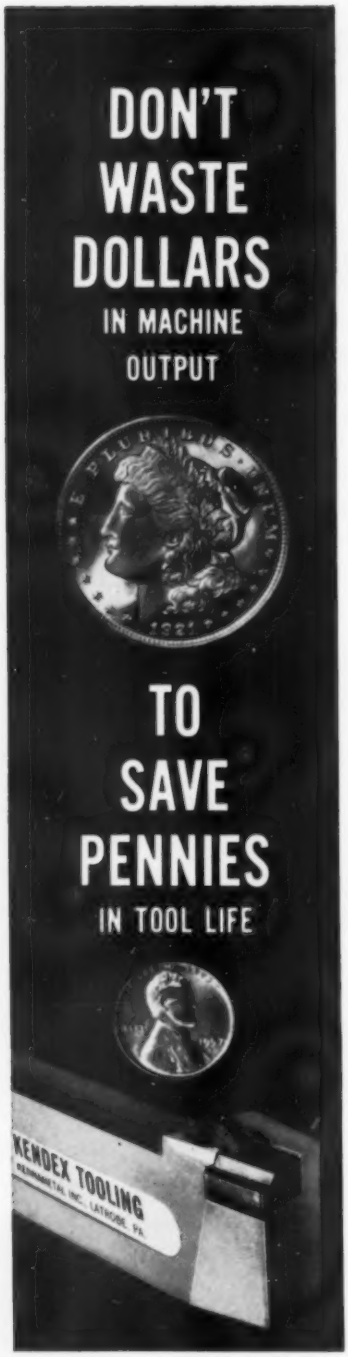

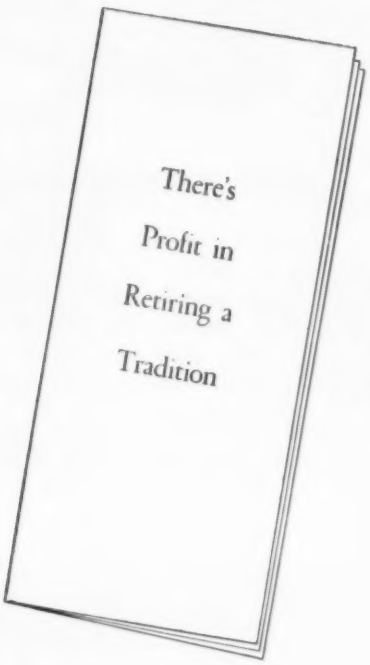

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With rising costs and increased competition from both foreign and domestic sources . . . you will find this a timely review of how some shops are reducing machining costs per piece by retiring certain outmoded ideas. As one plant owner did, perhaps you too will conclude . . . "A cutting edge on an indexable carbide insert that costs only a few cents is an extremely small price to pay for the efficient use of machines costing thousands of dollars."

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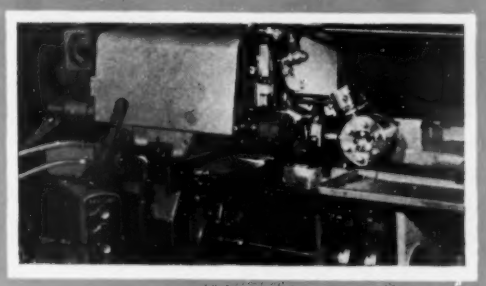
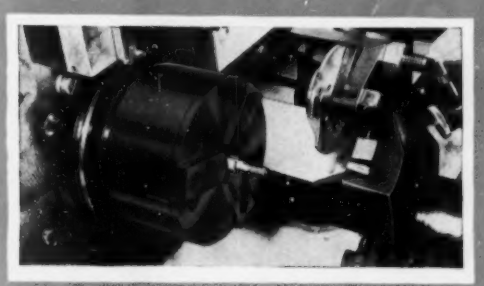
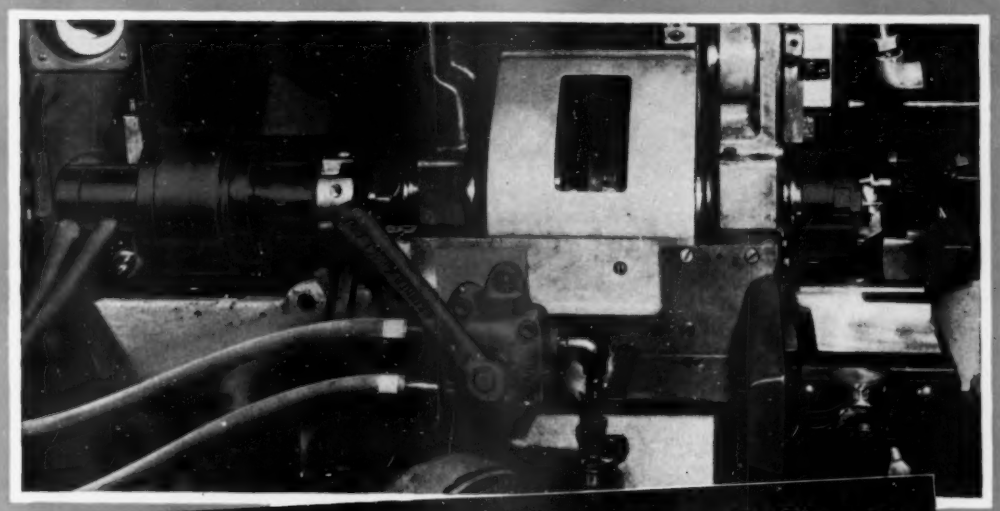
	240-Minute Tool Life Setup	25-Minute Tool Life Setup	75-Minute Tool Life Setup	25-Minute Tool Life Setup	120-Minute Tool Life Setup	80-Minute Tool Life Setup	120-Minute Tool Life Setup	22-Minute Tool Life Setup
Machine Cost per Hour	$ 8.00	$ 8.00	$10.00	$10.00	$ 9.00	$ 9.00	$ 9.00	$ 9.00
Tool Cost per Hour	$ .04	$ .40	$ .36	$ .76	$ .14	$ .215	$ .14	$ .77
Cost per 8-Hour Shift	$64.32	$67.20	$82.88	$86.08	$73.12	$73.72	$73.12	$78.16
Pieces per Shift	51	181	8	17	94 hrs./pc.	41 hrs./pc.	8	16
Cost per Piece	**$ 1.26**	**$ .37**	**$10.36**	**$ 5.06**	**$859.16**	**$377.81**	**$ 9.14**	**$ 4.88**
Cost Reduction	70%		51%		56%		47%	







Now You Can Convert Your Brown & Sharpe Automatic Screw Machine to Air Chucking

It is now possible to convert the Brown & Sharpe Automatic Screw Machine to power chucking by means of a Skinner power chucking unit designed for the Models 2 and 2G.

The Skinner power chucking unit consists of a 4-inch air chuck with two or three jaws, soft blank work-holding top jaws, a threaded draw bar, a rotating air cylinder, a cylinder adapter and a control valve. This unit can be installed easily in ninety minutes by any set-up man.

With the addition of this Skinner power chucking unit, your Brown & Sharpe Automatic Screw Machine can chuck cold drawn and odd shaped parts at higher speeds and at less cost.

For greater production, automatic feed hoppers, work ejectors and automatic cam controls can be added to provide automatic chucking that will permit an operator to tend more than one machine.

If you plan to purchase a Brown & Sharpe Automatic Screw Machine ask to have the Skinner power chucking unit included. To convert your present Model 2 or 2G, contact a Skinner Representative or write us at Dept. 188.

SKINNER CHUCKS

THE CREST OF QUALITY

SKINNER CHUCKS

THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT

3 short steps to longer tool life with the

Brush Surfindicator

The Brush Surfindicator can increase your tool life *up to 50%* by setting microinch specifications on

(1) The *cutting edge* of the tool for optimum cutting efficiency.

(2) The stock surface to arrive at the most efficient cutting *angle* of the tool.

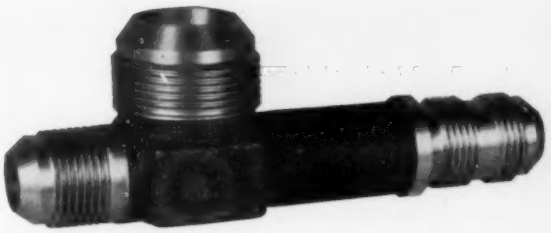
(3) The surface finish to determine exact *point* in the production run at which to *replace* the tool.

Your production runs can be lengthened—machine shutdowns and rejects reduced—your quality maintained with the Brush Surfindicator.

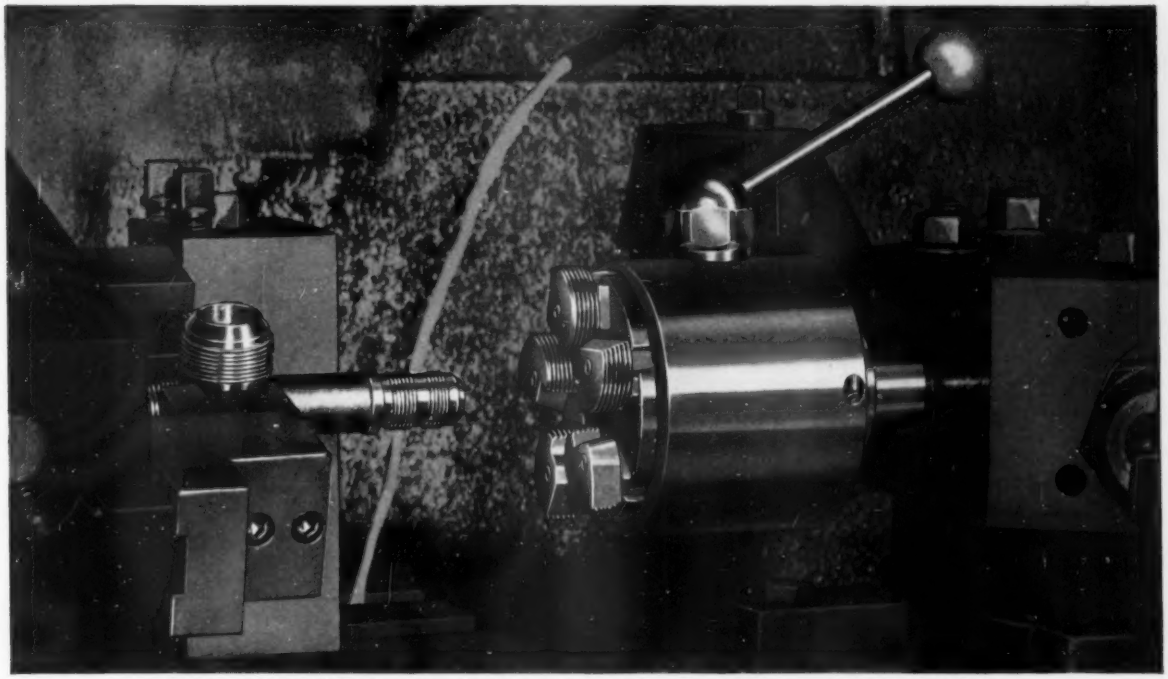
A demonstration can be arranged in your plant. Call us—set a date—we'll be there!

brush INSTRUMENTS
DIVISION OF
37TH AND PERKINS **CLEVITE** CORPORATION CLEVELAND 14, OHIO

When Threading Specs Read A.Q.R....*



Parker standardizes on 5 Chaser Vers-O-Tools



1⅛—12 and 1⅜—12 threads cut on this 316 stainless steel forging. A 30 microinch finish is maintained.

*"Additional Quality Required" are by-words for this leading manufacturer of precision fittings. The rigid specifications for critical missile components produced in their Cleveland, Ohio plant demand *better than aircraft quality*. "That's why we use Namco Vers-O-Tools almost exclusively," says D. S. Manning, Manager, Parker Fittings & Hose Division, Parker-Hannifin Corporation. "These automatic 5 chaser die-heads eliminate lead error, taper and grooves on the thread flank . . . with overall thread quality at least 50% better than 4 chaser heads. The result is precision fittings with true seating surfaces and a perfect gauge fit."

Prove these facts for yourself: more pieces per grind; precision threading of parts with undercuts, flats, slots; unsurpassed economies in chaser grinding and precise relocation of chasers without readjustment . . . *and* a complete range of sizes. Namco 5 chaser Vers-O-Tools are only a part of a complete line of threading tools designed to provide the tolerances and finish required for *your* toughest jobs. Write for complete information.

National Acme

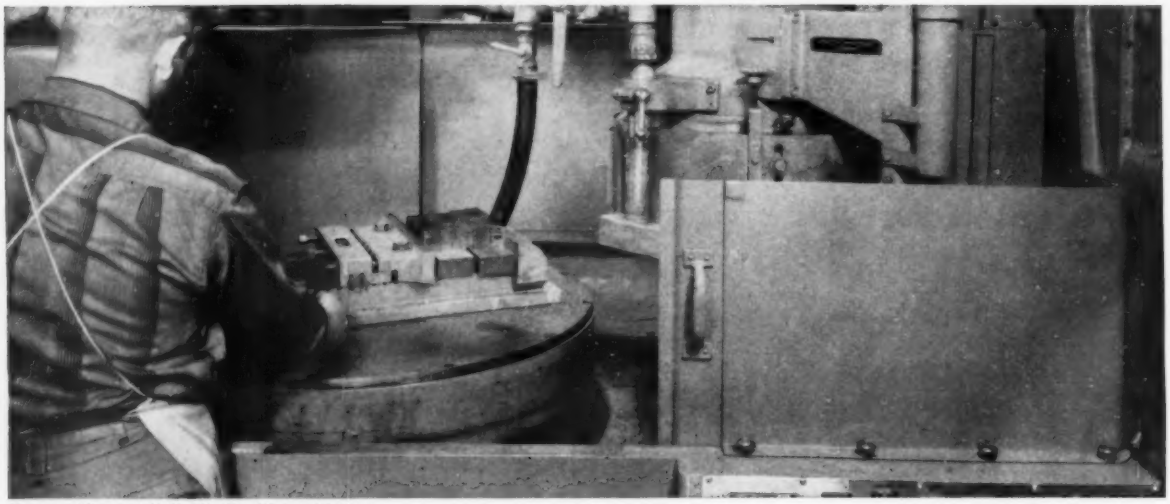
The National Acme Company
193 E. 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.

MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

Fast, new grinding method replaces cutter-type machining

Betters production time by 75% . . removes up to ¼ in. stock per side . . . *economically*



Courtesy: Alignment Engineering Co., Warren, Michigan

Fig. 1—No. 24 vertical-spindle rotary pulls up to 60 hp through the spindle. Grinding mild steel, this rugged machine removes metal up to three times faster than conventional surface grinders. With this in mind, many plants (like this one) are buying them as a stock-removal tool.

Three shapers replaced . . . machining time cut from 6 to 1½ hr. . . . up to ¼ in. stock removal per side economical with new method . . .

These are results from a Michigan company (typical jobs shown) after installation of a Mattison No. 24 vertical-spindle surface grinder with Quick-Tilt spindle. Such performance proves that a rigid, high-powered vertical is now . . . more than ever . . . a stock-removal machine as well as a precision grinder.

Two machines for the price of one

Until the introduction of the Quick-Tilt spindle rotary late last year, grinding dead flat parts on a production basis meant you had to accept one of two types of inefficiency: (1) excessive downtime for changing one machine from a rougher to a finisher . . . or (2) "two-timing"—keeping two grinders set up for successive roughing and finishing.

Now, a flick of the switch tilts the spindle for rough and finish operations in a single setup, without even stopping the machine. In effect, this gives you two machines for the price of one. But, that's only part of the story.

The Quick-Tilt rotary does more than provide a dual cycle on one grinder. It combines high horsepower (60 on the No. 24—100 on the No. 36) and rugged construction, with the best features available for precision, fine-finish work.

Fig. 2—Quick-Tilt improves accuracy, too. Parts requiring extremely close tolerances can be ground faster, utilizing full table capacity.

Hidden savings a big factor

Another reason why it pays to own a new Mattison is reduction of hidden costs. You can reduce your stock allowances for grinding and eliminate cutter-type machining of flat surfaces. With self-dressing wheels, machine downtime for changing the cutting tool and cost of re-sharpening can be eliminated. This is important because actual machining time on a surface grinder is often less than on a machine that produces much bigger chips. Improved finish and accuracy are a bonus. And don't forget—hard spots, burned edges, and tough outer scale are no problem for a grinding wheel.

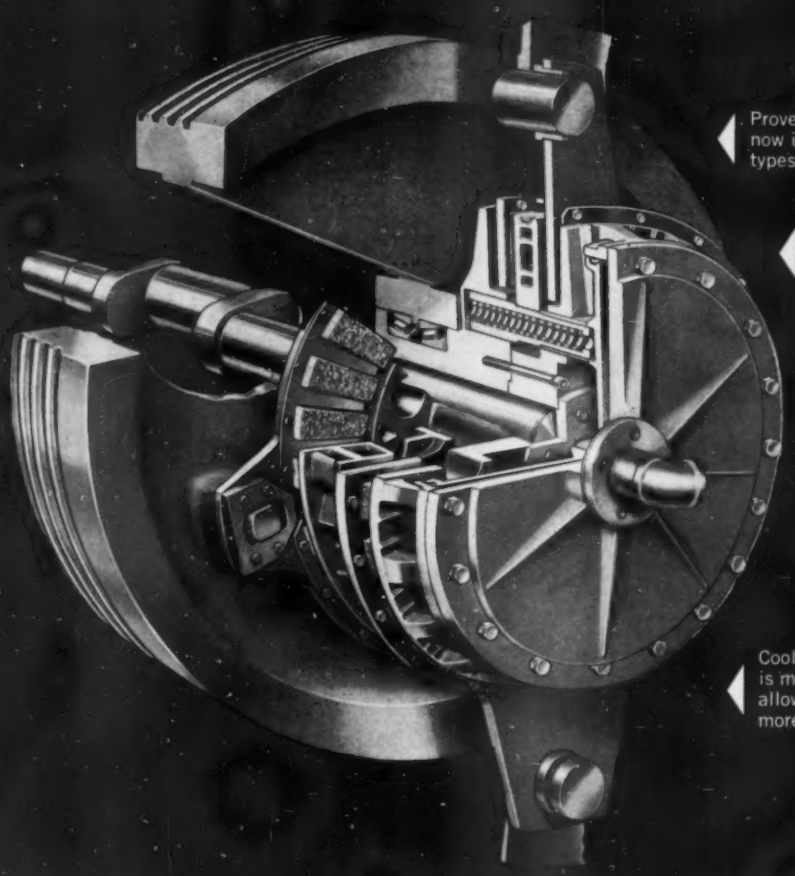
To the grinding man all these advantages add up to *maximum versatility in a standard machine.*

Ask for a test grind

We don't expect you to rush through a purchase order for a new grinder on the strength of this ad. But, if it seems to make sense in terms of your particular machining problems and costs, we do hope you'll investigate further. Send us your piece-parts for a sample grind in the Mattison Methods Lab. There's no cost (other than shipping expense) for a complete report covering stock removal, wheel life, production rate, wheel specs, surface finish, accuracy, etc. Your Mattison dealer will make all the arrangements—or, phone the factory direct.

MATTISON MACHINE WORKS
Rockford, Illinois • WOodland 2-5521

MATTISON MACHINE WORKS
HIGH-POWERED PRECISION SURFACE GRINDERS



Proved design... hundreds now in daily use under all types of conditions.

Fast acting... only a fraction of inch movement between full clutch engagement and full brake.

Easy to service... with everything outside, clutch plates are easy to get at... easy to change... no disassembly required.

Self-aligning... discs "float" in mountings, align automatically. Plates also automatically compensate for wear—no adjustment needed.

Cool-running... everything is mounted on outside, allows heat to dissipate more rapidly.

New Bliss combination clutch and brake for inclinables...

RUNS COOLER UNDER TOUGH OPERATING CONDITIONS
SINGLE TRIPS FASTER... ALWAYS TOP STOPS!

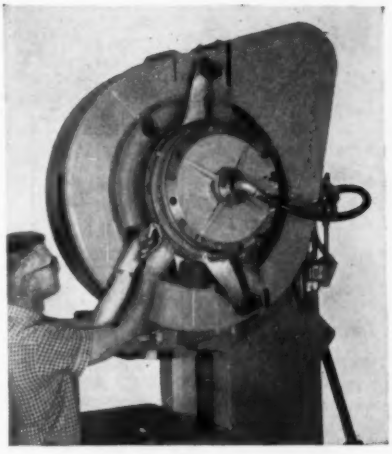
Here is a new combination clutch and brake that is rewriting the standards for inclinable press production.

It's an exceptionally fast operating clutch... one that licks the usual maintenance problems associated with high speed clutches.

Everything is mounted on the *outside*... the clutch is thus kept in open air *away* from the press frame... it dissipates heat far faster and there is no danger of bearing oil getting on the clutch plates—both factors that contribute to longer life.

An equally important feature is its universal top stopping. It practically eliminates the possibility of damaging dies through double-tripping; the new CK top stops every time; ram and feeds are always in synchronization.

Bliss' new CK clutch is designed for crankshaft mounting on flywheel inclinables and main gear mounting on geared inclinable presses. In either case, it runs faster *longer*. Why not get the complete facts on this important new development today?



BLISS
SINCE 1857

E. W. BLISS COMPANY · Canton, Ohio

BLISS is more than a name—it's a guarantee

PRESSES • ROLLING MILLS • ROLLS • DIE SETS • CONTAINER MACHINERY • CONTRACT MFG.

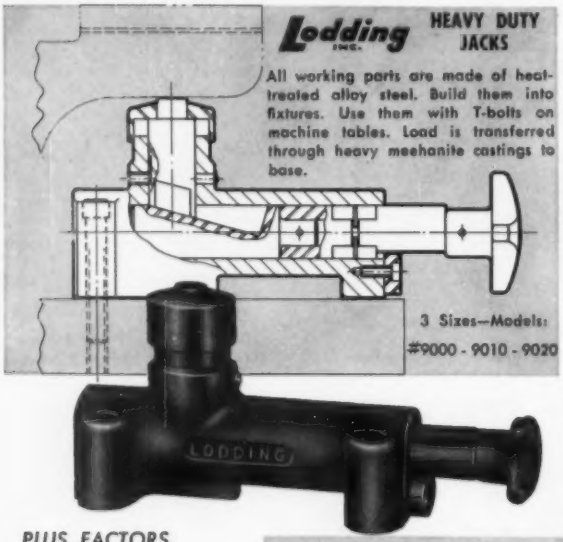
USE READER SERVICE CARD, CIRCLE 97

PREFERRED

because it

...SAVES MONEY
...SAVES TIME

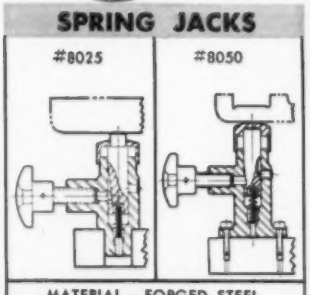
The acknowledged leader in its field, LODDING appreciates the recognition and commendation it has received from the nation's outstanding tool engineers.


Lodding INC.
HEAVY DUTY JACKS
All working parts are made of heat-treated alloy steel. Build them into fixtures. Use them with T-bolts on machine tables. Load is transferred through heavy meehanite castings to base.
3 Sizes—Models:
#9000 - 9010 - 9020
LODDING

PLUS FACTORS

- ✓ Longer life
- ✓ Greater service-ability
- ✓ All moving parts are heat treated and ground
- ✓ Forged tool steel material

TRACING TEMPLATES AVAILABLE
For information write



Lodding INC.

AUBURN, MASSACHUSETTS

FACTORY WAREHOUSES

Goodwin-Snader Co. 6814 S. Western Ave. Los Angeles 47, Calif. PLeasant 3-1553	Bagby Engineering Co. 1047 Forest Ave. Evanston, Ill. AMbassador 2-2273	Southern Tool Supply Co. 54 11th St. No. East Atlanta 9, Ga. TRinity 5-7065

USE READER SERVICE CARD, CIRCLE 98

S-T-R-E-T-C-H MACHINE HOURS KNOW YOUR SPEEDS use JONES TACHOMETERS

Assure Higher Production — Quality Control Increased Economy — Safety

SERVING MANY INDUSTRIES: textiles, plastics, chemical, rubber, paper and film, box and boxboard, automobile, marine, pulp and paper, railroad, and many others.

GUARANTEED ACCURACY: superior construction, trouble-free, unaffected by moisture, temperatures, electric currents. Reads in R.P.M. Y.P.M. F.P.M. G.P.M. etc.

GREATEST VISIBILITY: Dial sizes 3" to 20"—reading range, full 360°.

You will find them indispensable, as numerous others have, for use on all types of industrial machines.

Write for catalogs 58 and 147-D

JONES MOTROLA CORP.
Stamford, Conn.

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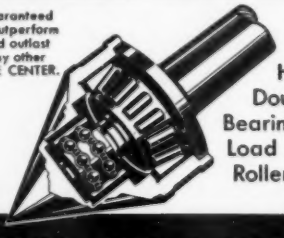
MARVECO LIVE CENTERS

Guaranteed to outperform and outlast any other LIVE CENTER.



The WHOLE HEAD turns on Double Row Ball Bearings for Radial Load and Tapered Roller Bearings for Thrust Load.

MARVEL TOOL & MACHINE CO.
1086 North River Road • St. Clair, Michigan

USE READER SERVICE CARD, CIRCLE 100

DYKEM STEEL BLUE

Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303D North 11th St. • St. Louis 6, Mo.

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USE READER SERVICE CARD, CIRCLE 102

HAVE YOU CHECKED THESE FACTS ON GUN DRILLING?

The Most Economical Gun Drilling Machine on the Market.

Utilizes the Full Potential of Modern Rotating Gun Drills.

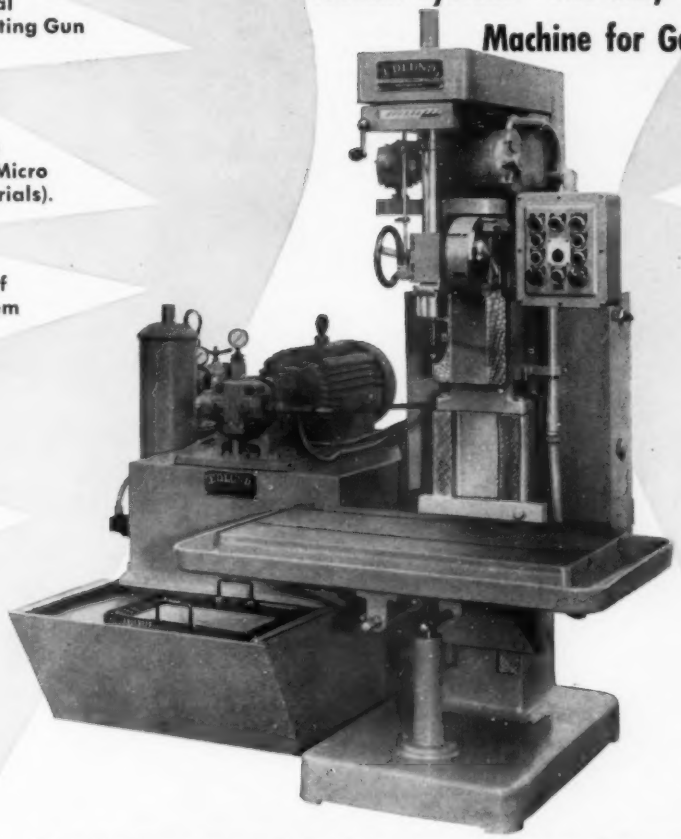
Deep, Accurate Holes with Fine Finish (2 to 32 Micro Inches in most materials).

Easy Drilling of Difficult Problem Holes.

Ability to Precision Drill Odd Shaped Pieces.

EDLUND

Gun Drilling Machine Model 2G and High Pressure Coolant System — The only Vertical Gun Drilling Machine for General Purpose Work.



Accurate Drilling of All Types of Material — Aluminum, Cast Iron, Brass, Tool Steel, Stainless, and other Steels.

Can Eliminate Second Operations — Reaming, Grinding, and Honing.

Write for descriptive Bulletin 2G or contact the EDLUND Representative in your area for complete information on the Vertical Gun Drilling Machine and Coolant System.

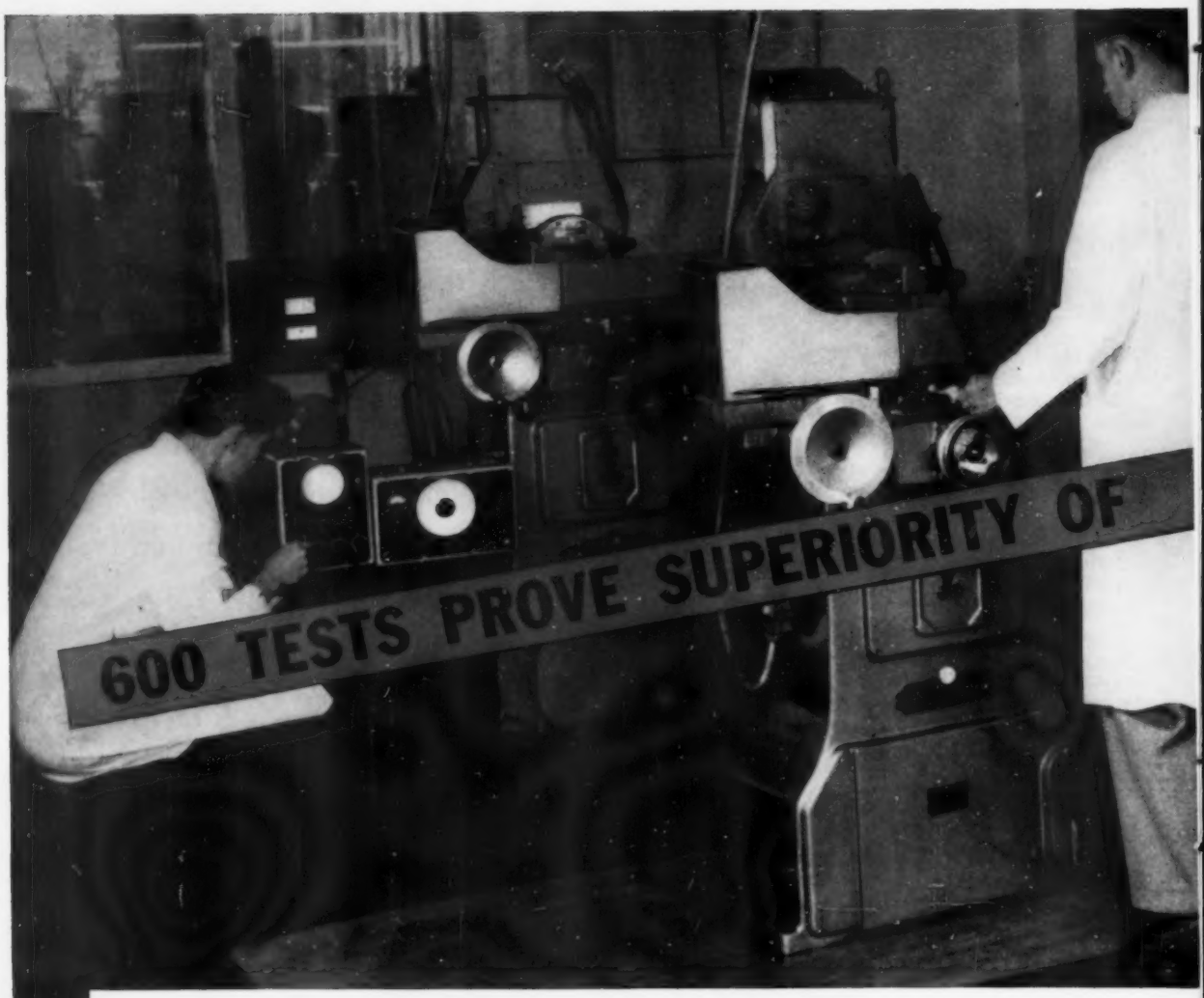
SPECIAL CONTRACT JOB WORK FOR GUN DRILLING CAN BE ARRANGED WITH EDLUND. SEND PART, BLUEPRINT AND REQUIREMENTS.

EDLUND REPRESENTATIVES IN MAJOR CITIES

EDLUND

MACHINERY COMPANY Cortland, New York

Division of Harsco Corporation



30% TO 50% LONGER LIFE FOR RESINOID-BONDED DIAMOND WHEELS

Six hundred separate trials, using 145 wheels, were run by the Diamond Research Laboratory to test a completely new type of natural diamond grit for resinoid wheels. The results: this new grit increases the life of natural diamond resinoid-bonded wheels by 30% to 50%.

The particles of this new grit do not readily pull out of the bond. Instead, they break down into ever-finer fragments which constantly expose new, sharp cutting surfaces.

TEST EQUIPMENT: Three 18" Jones & Shipman production grinders were fitted with special spindles to enable wheels to operate at 5500 surface feet per minute, the speed generally used in diamond grinding.

The wheels were of the D1A1 type, 6" in diameter, 3/16" face width, with 1/8" depth of resin. Each wheel contained 31 1/4 carats of the new grit. Metal to be ground was tungsten carbide of the same quality normally used for milling cutters, lathe tools, etc. During the course of the tests, 700 pounds of hardest carbide were ground away.

RESULTS: This new friable grit, Selected Natural Diamond (SND-RESINOID), increases the life of natural diamond resinoid wheels by 30% to 50%, depending on the type of job at hand. The grit will be available to your wheel manufacturer soon. Next time you order diamond resinoid wheels, specify SND-RESINOID . . . the most economical *and* the most efficient grit you can use.

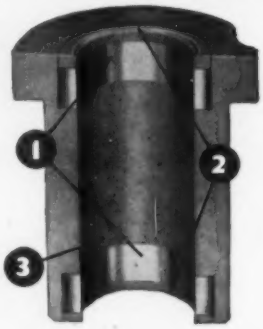
Tests were run on these three Jones & Shipman production grinders. Results showed that the new grit, Selected Natural Diamond (SND-RESINOID), increases the life span of natural diamond resinoid wheels by 30% to 50%.

INDUSTRIAL DISTRIBUTORS (SALES), LTD.

YOU CAN DEPEND ON NATURAL DIAMONDS

CARBIDE INSERTED MEYCO BUSHINGS Can Cut Production Costs!

MEYCO carbide inserted drill jig bushings have been successfully saving money on production runs for the past decade. Performance: same as solid carbide, but need not be handled with kid gloves. Greater economy, because of long life at less cost. You can enjoy the advantages of greater accuracy for a longer time, less spoilage, less machine down-time, added drill and jig life with MEYCO carbide inserted drill jig bushings. Get the full story now: write for new Bushing Catalog No. 42.



***PATENTED**

1. Tungsten carbide rings at the points of wear; 2. Steel rings protect drills and carbide; 3. Special hardened alloy steel body.

W. F. MEYERS CO., INC., BEDFORD, IND.

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DONT GAMBLE

USE *Only* CARR-LANE *"Tool Proven"*... JIG AND FIXTURE COMPONENTS

● ALL ITEMS PRECISION MADE, HEAT TREATED AND RUST PROOFED

Carr Lane MANUFACTURING CO.
4200 KRAUSE COURT
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SOUTHWEST "Monoball" SELF-ALIGNING BEARINGS

CHARACTERISTICS

	ANALYSIS	RECOMMENDED USE
1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for Engineering Manual No. 551. Address Dept.

SOUTHWEST PRODUCTS CO.
1705 SO. MOUNTAIN AVE., MONROVIA, CALIFORNIA

USE READER SERVICE CARD, CIRCLE 105

TO OBTAIN FURTHER INFORMATION ABOUT ADVERTISERS, TRADE LITERATURE OR TOOLS OF TODAY APPEARING IN THIS ISSUE OF THE TOOL ENGINEER, USE THE HANDY READERS SERVICE CARD ON PAGE 145.

Electronic parts courtesy Judson Mfg. Co., Inc., Cornwells Heights, Pa.

Mirror-bright without polishing, after switch to Sunicut

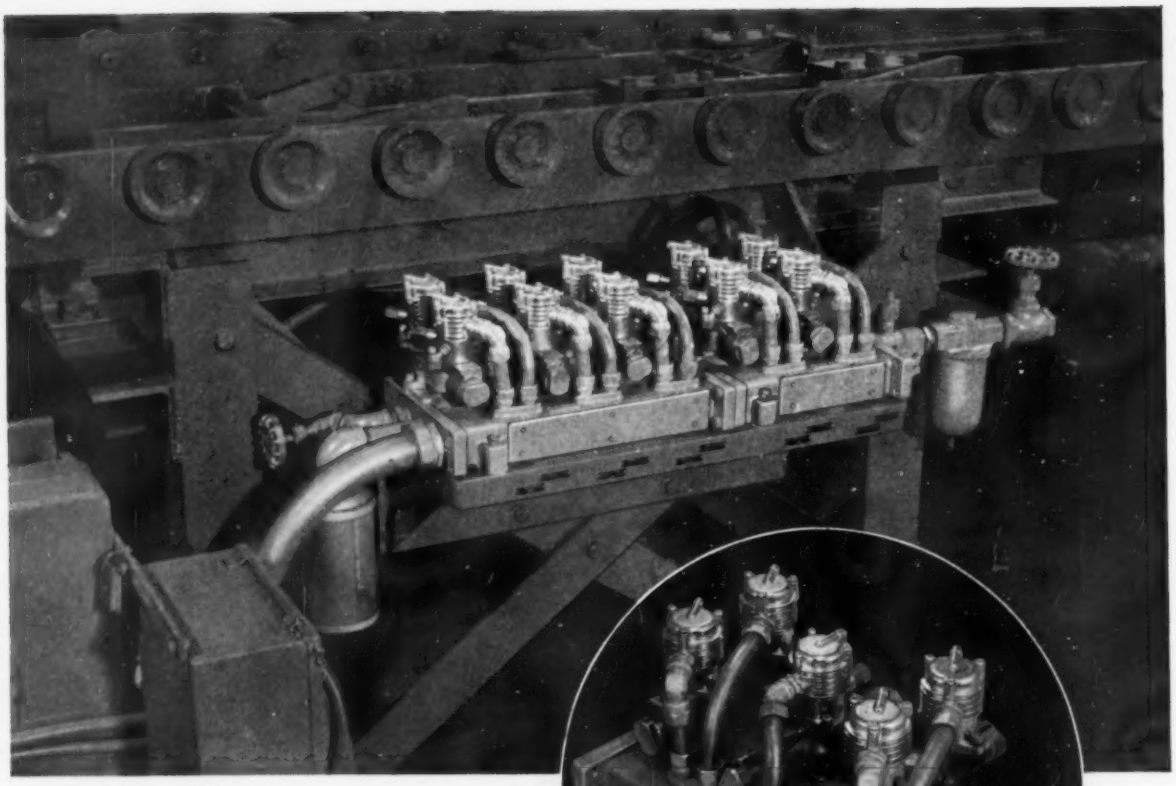
Boring on a multiple-spindle automatic produced the finish you see on these electronic parts. Sunicut 102-S Cutting Oil saved time and money by eliminating the polishing operation. The same automatic uses Sunicut 102-S to machine metals ranging from titanium to stainless 410.

Sunicut 102-S is one of a full line of cutting oils known throughout metalworking for maintaining long tool life, close tolerances, and fine finishes. There's a grade of Sunicut that can help you improve your product quality—and *that's* the best economy of all.

To choose the right Sunicut, ask the Sun man; that's part of his service to you. Or write to SUN OIL COMPANY, Dept. TE-8, *Philadelphia 3, Pa. In Canada: Sun Oil Company Limited, Toronto and Montreal.*

SUNOCO

MAKERS OF FAMOUS CUSTOM-BLENDED BLUE SUNOCO GASOLINES



This bank of manifold-mounted Speed King valves controls a foundry mold flask indexing unit, custom-built for a major automotive manufacturer.

to simplify piping and wiring of complex control valve installations, use...

VALVAIR'S NEW SPEED KING® MANIFOLDS

Cut material and assembly labor costs on multiple control valve installations . . . use Valvair's new 2 and 3-station manifolds! Common inlet, exhaust and wiring passages, plus equally-spaced cylinder ports, eliminate unnecessary piping and wiring . . . keep installations neat. Cast aluminum manifolds may be ganged for installation of any number of valves. O-rings assure leak-free connections.

VALVES — 2 or 3 stations for ⅜-¾ in. NPT standard Speed King or ¼ in. NPT plug-in Speed King Valves, single or double solenoid, 2, 3 or 4-way. Remote operated, speed controlled* and power-centered neutral* valves may be used in any number and combination.

PIPING — Intake and exhaust ports common to all stations. Pipe threads, both ends, and O-ring grooves.

PORTING — Optional size cylinder ports. Side and bottom outlets, flush pipe plugs.

WIRING — Large conduit passage, with side access cover, common to all stations. Pipe threads, both ends, and O-ring grooves. Pilot leads (standard Speed King valves) encased in flexible conduit, integral pilot connections for ¼ in. NPT plug-in Speed Kings.

MOUNTING — 2 mounting points per manifold. For ganging, kits of O-rings and through bolts are offered.

**Standard Speed King valves only.*

Easier in-use service is another benefit! Individual pilots, valves or entire manifolds are replaceable as units to minimize machine downtime.

And, Speed King manifolds *are available for immediate delivery from stock.* Before you engineer new equipment or up-grade machines now in service, investigate the design and cost advantages of Valvair Speed King manifolds.

For more information, write for Bulletin D-58. Address Dept. TE-859, Valvair Corporation, 454 Morgan Ave., Akron 11, Ohio.

Representatives in principal cities.

Valvair AKRON 11, OHIO

Other INDUSTRIAL DIVISIONS of IBEC The Sinclair-Collins Valve Co The Bellows Co., Akron, Ohio • V D Anderson Co., Cleveland, Ohio

B005

New concept in productivity...*

Brown & Sharpe Model B Turret Drilling Machine...

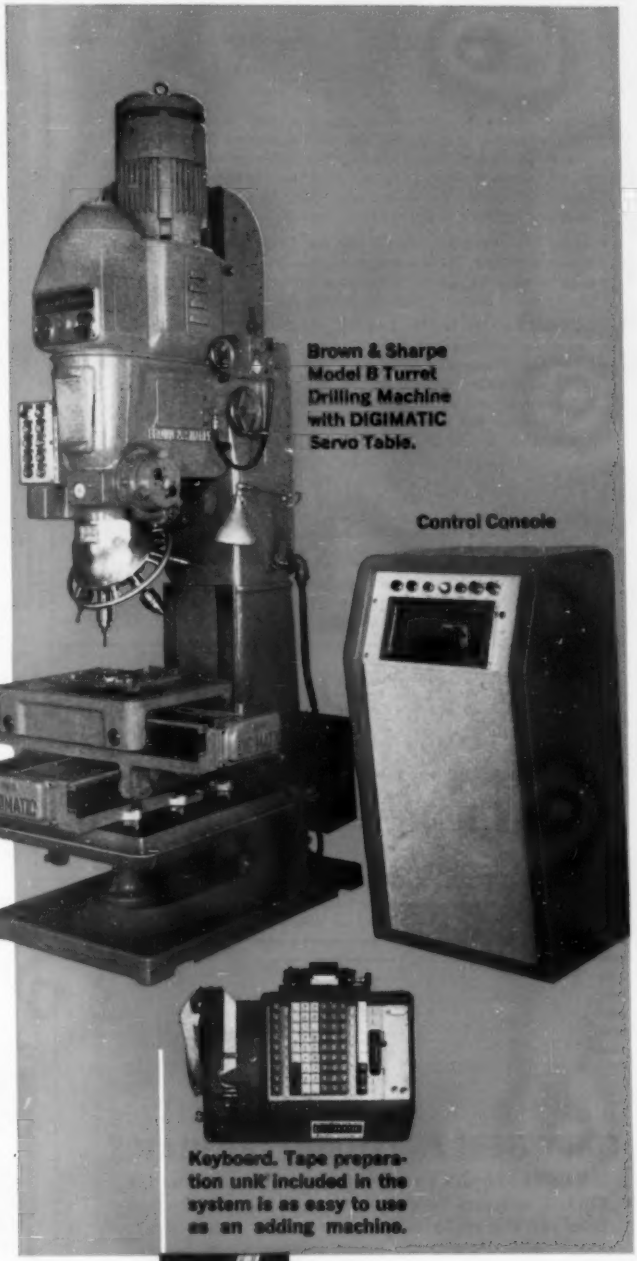
DIGIMATIC† Model 202 Point-Positioning System

. . . combine to give you the lowest-cost complete tape-controlled turret drilling system for:
drilling • tapping • boring • reaming

- New freedom in designing
- Engineering changes effective immediately (change tape, not tooling)
- Tighter machine scheduling
- Lead time and tooling costs cut drastically
- Expensive jigs and templates eliminated

ASK US TO ARRANGE A DEMONSTRATION WITH YOUR BLUEPRINT AND YOUR PART. Write for the free booklet, "DIGIMATIC Model 202 Point-Positioning System." Also: movies shown at your plant or shop on request.

†DIGIMATIC is our trademark.



Brown & Sharpe Model B Turret Drilling Machine with DIGIMATIC Servo Table.

Control Console

Keyboard. Tape preparation unit included in the system is as easy to use as an adding machine.

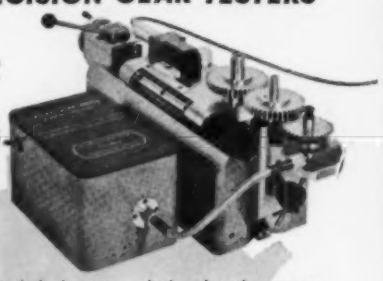
Tooling With Tape

STROMBERG-CARLSON
A DIVISION OF **GENERAL DYNAMICS**
1494 N. GOODMAN STREET • ROCHESTER 3, NEW YORK

GOULDER *PRECISION GEAR TESTERS*

NO. 1 ROLLING GEAR TESTER

- Capacity up to 4 in. centers. Suitable for gears from 20 D. P. to 150 D. P. between .250 in. and 5 in. diameter.
- Designed specially for gears used in high accuracy radar and similar equipment.
- All types of shafts, gears, bevels, worms, racks, splineshaft, etc. are covered by a wide range of attachments. Vertical Adjustment.
- Power operation and recording available.



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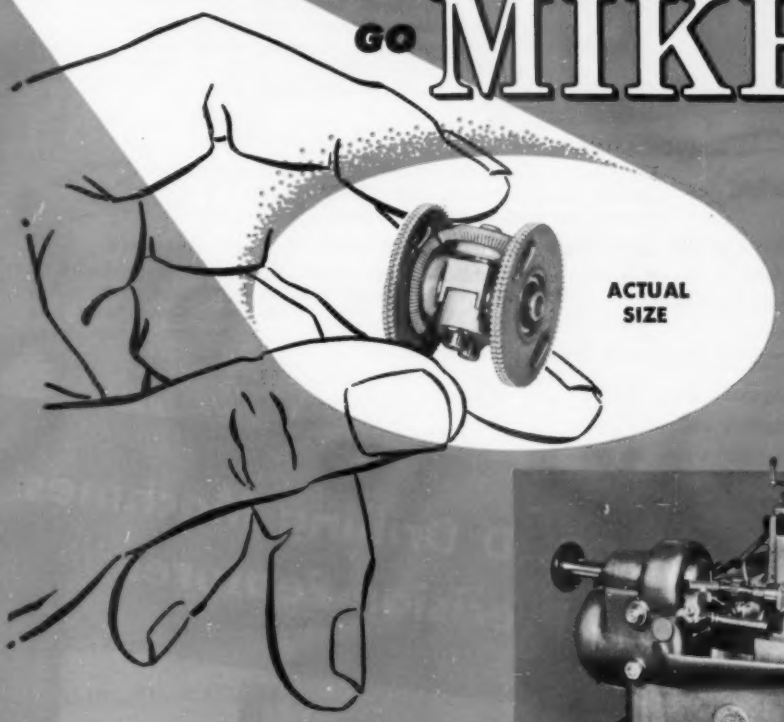

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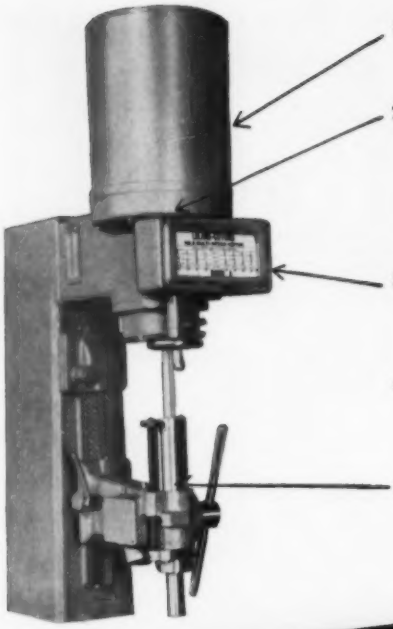

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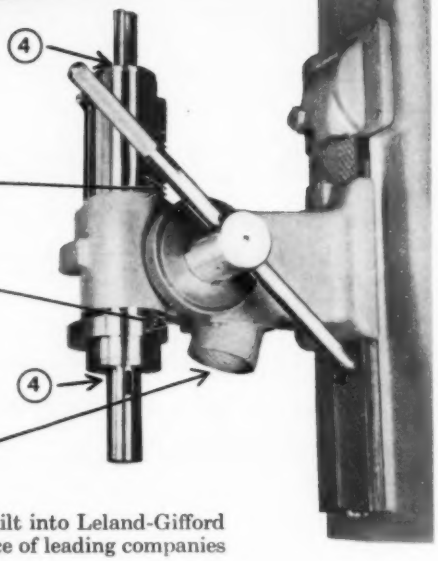

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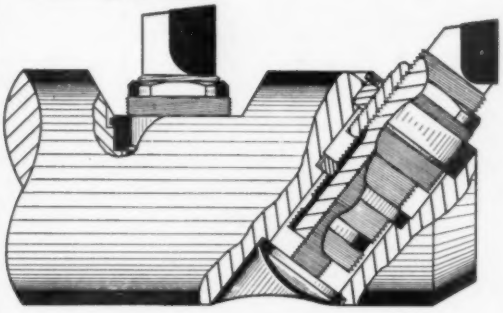

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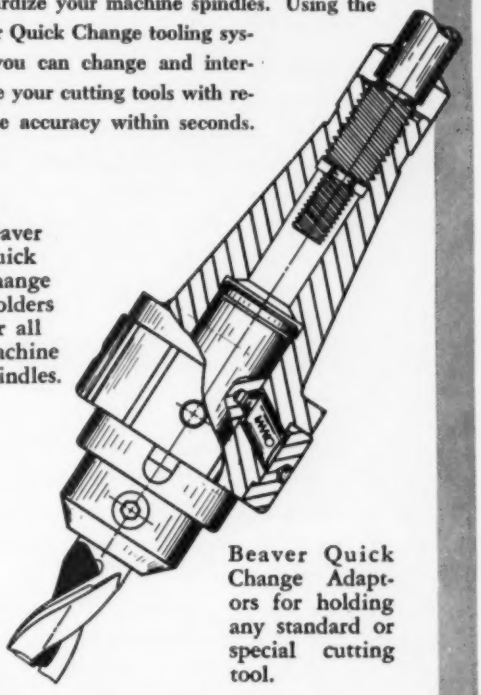
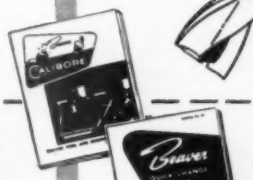


Beaver Quick Change Adaptors for holding any standard or special cutting tool.



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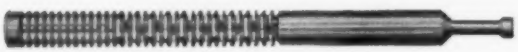

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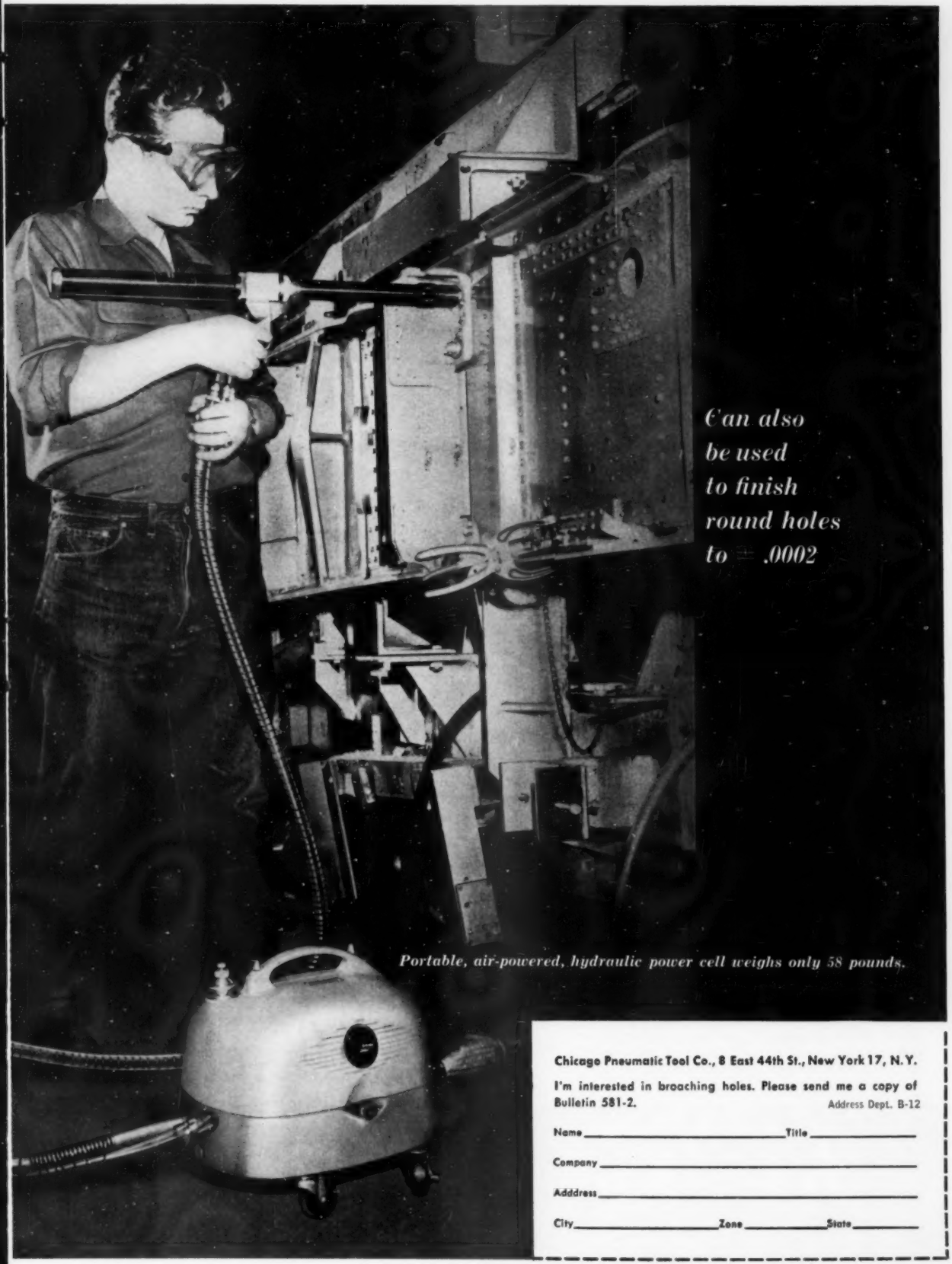

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A reliable method for measuring the cooling characteristics of cutting fluids under actual cutting conditions. Do you know. . . .

- *"Chip curl" influences cooling action of cutting fluids. . .*
- *A fluid can be* too good *a coolant. . .*
- *Fine-finish benefits of cutting fluid are controlled by tool temperature.*

These and other previously unknown facts are discussed in detail in ASTE Research Report #19, "The Cooling Characteristics of Cutting Fluids," just published by the American Society of Tool Engineers' Research Fund. The Report is available to ASTE members at a cost of $.75 each and to non-members at $1.50. Orders should be addressed to ASTE Research Fund Director, 10700 Puritan Avenue, Detroit 38, Michigan.

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For more operations or larger parts than the regular indexing machines can handle. 8 to 14 stations. 43- or 63- inch index table. Horizontal units mounted on knees. Easy access to tools.

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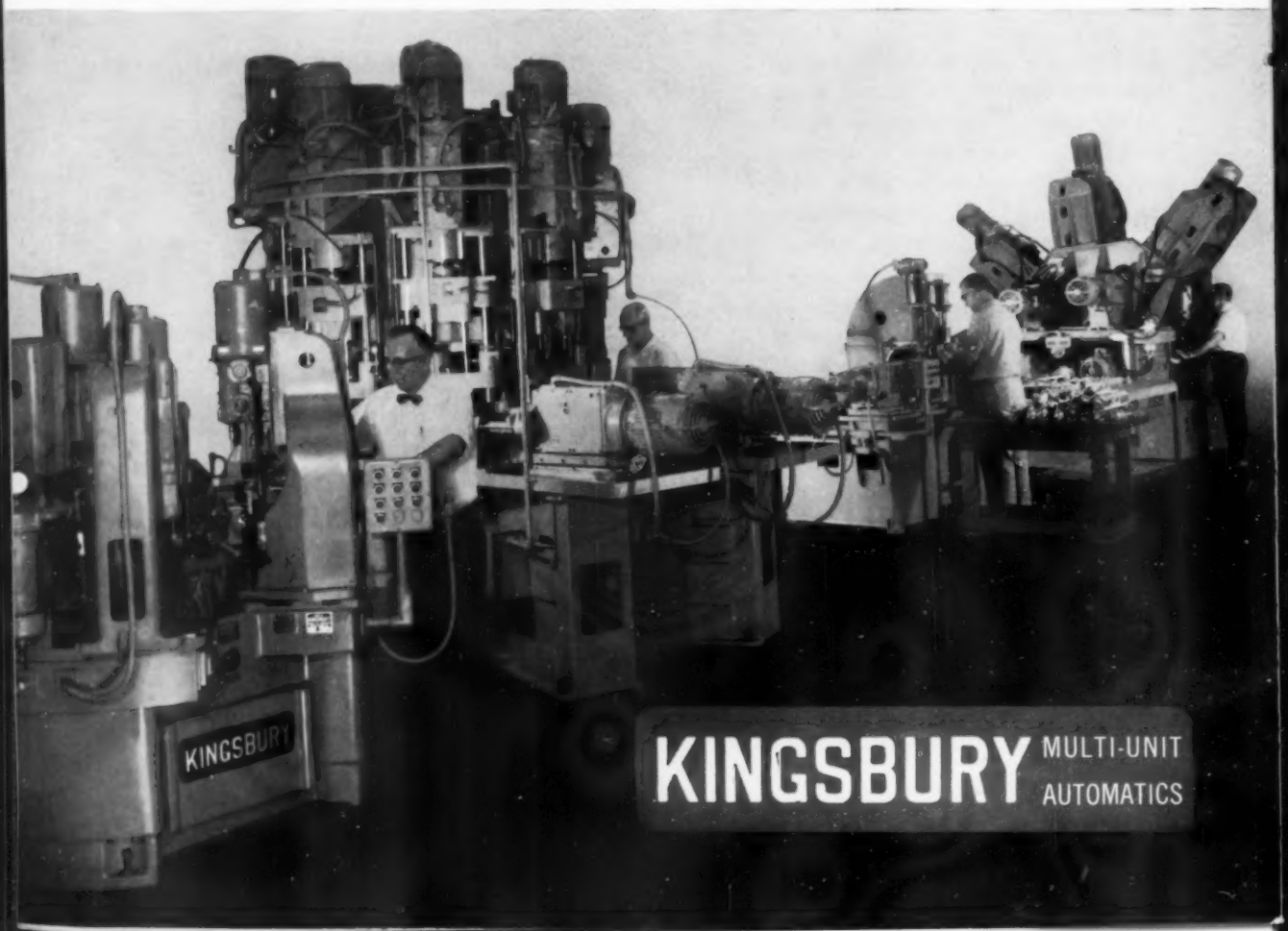
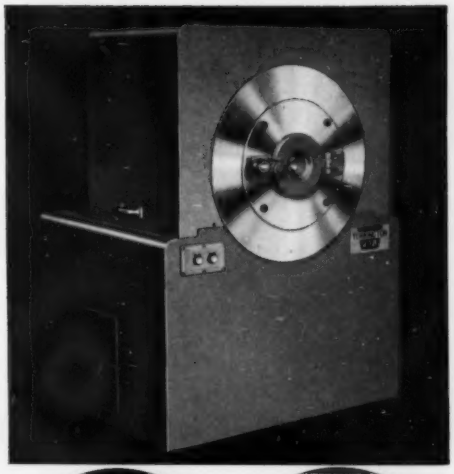
For successive operations from opposed directions with up to 5 horizontal units on each side of the machine. Up to 4 radial units provide a third direction. 8 stations in a vertical plane.





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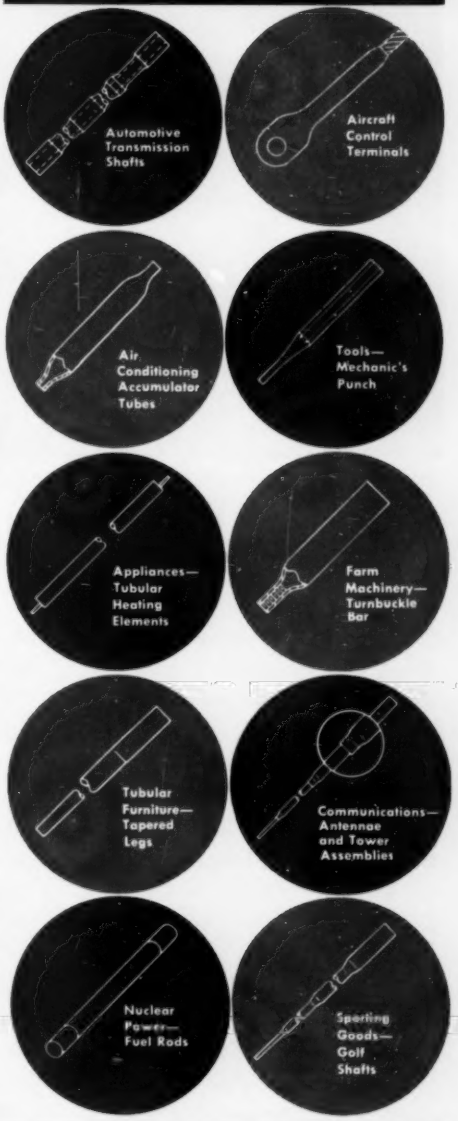

These versatile, efficient machines shape metal parts by hammering between dies instead of cutting stock away. They give you a full pound of parts from every pound of metal. They also save you time and labor. Swaging is usually the fastest way to point, taper, reduce or bond metal parts. Tooling is simple and surprisingly inexpensive.

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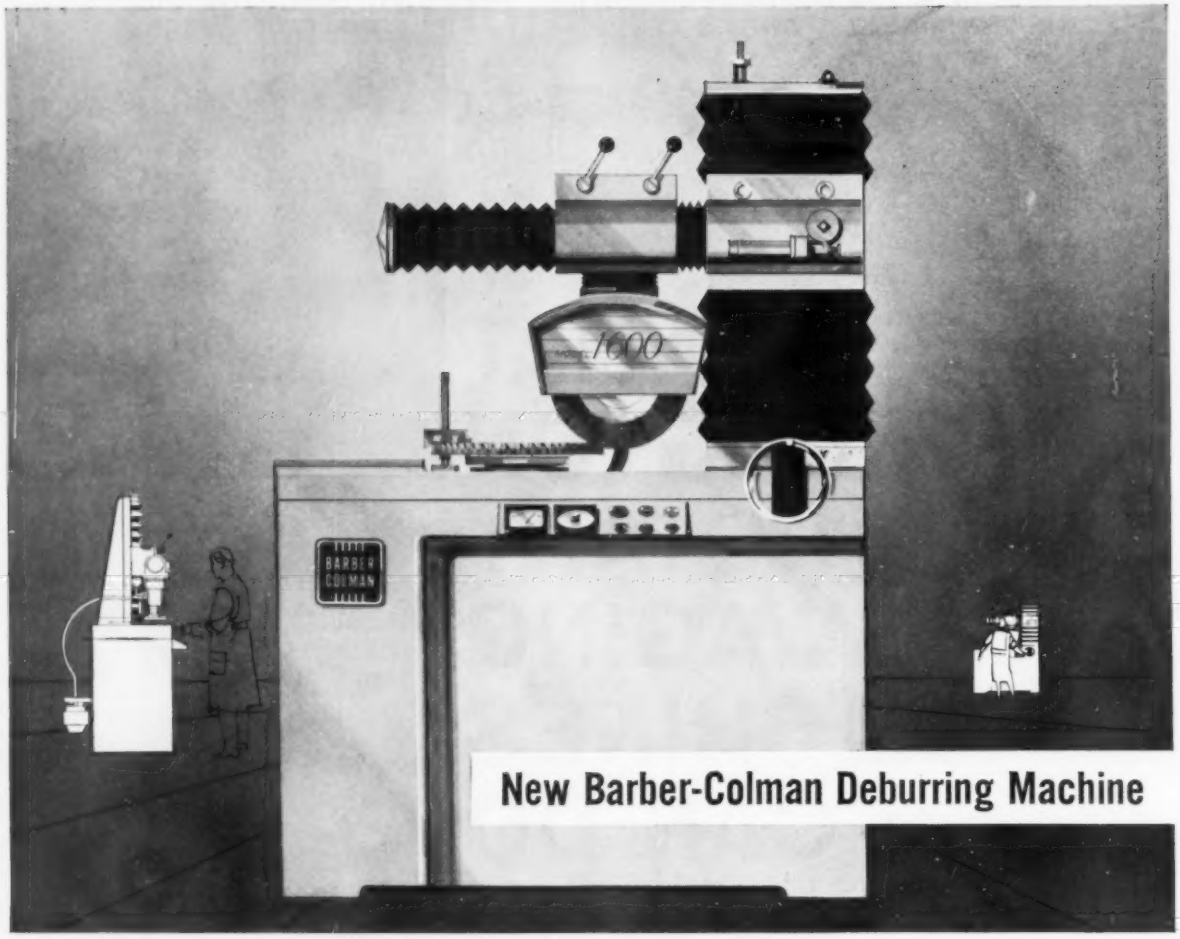


Fast, Efficient Gear Deburring

Deburring of spur and helical gears and sprockets is now fast, easy, and accurately controlled using a 3M "PG" wheel on the Barber-Colman Deburring Machine. This new method, developed by 3M Company and Barber-Colman Company, does not leave a burr on either the tooth profiles or the face of the gear. Also, it can grind a small chamfer on the complete tooth profile when required. Gears up to 16" diameter can be deburred on the Model 1600 machine. For fine-pitch gears, a smaller machine using a 6" PG wheel will be available. The same process also can be applied to deburring of gears larger than 16" diameter.

This versatile machine is designed specifically for the deburring of gears and other toothed forms using the "PG" wheel. It is automatic cycling, and most gears can be deburred in a matter of a few seconds. The formed wheel, which is dressed easily on the machine, rotates in timed relationship with the work. After the first dressing, wheels require no further maintenance. The wheel is fed automatically into the work a predetermined amount during each cycle and is engaged with the work for a predetermined length of time. After the initial setup, the operator just loads and unloads the machine.

For further information, contact your nearest Barber-Colman representative or the factory. We will be glad to arrange a demonstration showing how this machine will deburr your parts.

Barber-Colman Company

BARBER COLMAN

63 Loomis Street, Rockford, Illinois

BATH Tap'n Gage TIMES

A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

Vol. 1 No. 8

Subject: Helpful Hints for Successful Tapping

The Drilled Hole:

The drilled hole should be of proper size; drilled straight and not out of round. For most applications, a thread height of 55% for smaller taps and 75% for larger taps will have more than sufficient strength. Excessive thread height may result in torn threads and high tap breakage. Tap drills used in malleable metals such as soft stainless steel, soft aluminum, copper, monel metal etc., should be the largest size permissible because these metals tend to flow to the crest of the minor diameter while being tapped. This results in a small minor diameter after the tapping operation. Where it is possible, bottoming holes should be recessed or drilled deeper than it is necessary to tap. When tapping a hole with a taper pipe tap, it is often helpful to taper ream before tapping. "Go" and "not go" cylindrical plug gages may be used to control the drilled hole size.

The Tapping Machine:

Use a tapping machine and tap holder suited for the work. Check the tapping machine spindle and holder for wear and alignment. If they are worn or out of line, oversize and bellmouth holes may result.

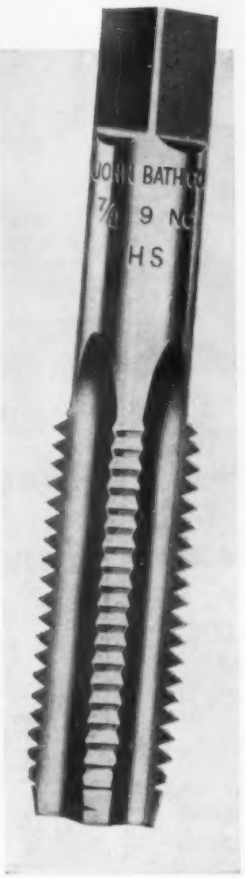
Lubrication:

The best lubricant for tapping depends on many variables such as the material to be tapped, the method of tapping and general conditions. The proper lubricant or cutting fluid can promote longer tap life, size control and higher tapping production. The correct lubricant can generally be determined by an oil company's representative who usually will make a survey and recommend the best lubricant for the specific tapping job.

Tapping Speeds:

There are many factors which affect proper tapping speeds, some of which are:

Material Factors: Thermo-conductivity of the material to be tapped and wall thickness as it affects heat dispersion; variations of carbon content of steel; hard spots in material; depth of hole to be tapped; thread height to be tapped.



Tap Factors: Major diameters, pitch and lead; style of tap; width of lands; amount of hook or rake; length of chamfer.

Mechanical Factors: Type of tapping machine and holder; condition of tapping machine; type of fixture; vertical or horizontal tapping (faster speeds for vertical tapping); method of feeding the tap; cutting fluid used and method of application. Generally the best speed for tapping is the highest speed that conditions permit.

Use a tap with the proper number of flutes, flute design, chamfer and pitch diameter for the job.

Avoid tapping a hole so deep that the flutes of the tap clog tight with chips. Tap breakage will result. When deep hole tapping is necessary, use one or more roughing taps and a finishing tap. Do not rough out a thread too close to the finished size. The finishing tap may bind in the thread and break; will rub instead of cut.

When starting to thread a hole, allow the tap to find its own lead. Do not attempt to force or retard the tap . . . this will cause a bellmouth hole.

Sharp taps are a must for successful tapping. Sharpen when necessary with the utmost care on one of the several types of machines on the market designed for this purpose. Do not sharpen taps by hand.

We have listed some of the most common tapping rules but there are many more depending upon the specific tapping job. Bath engineers will recommend proper taps and give tapping advice on application.

Clip and mail coupon NOW!

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I would like to receive blueprints on the proper method of sharpening taps. Send to:

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Detroit **April 21-28**

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- • • • • PLANT TOURS

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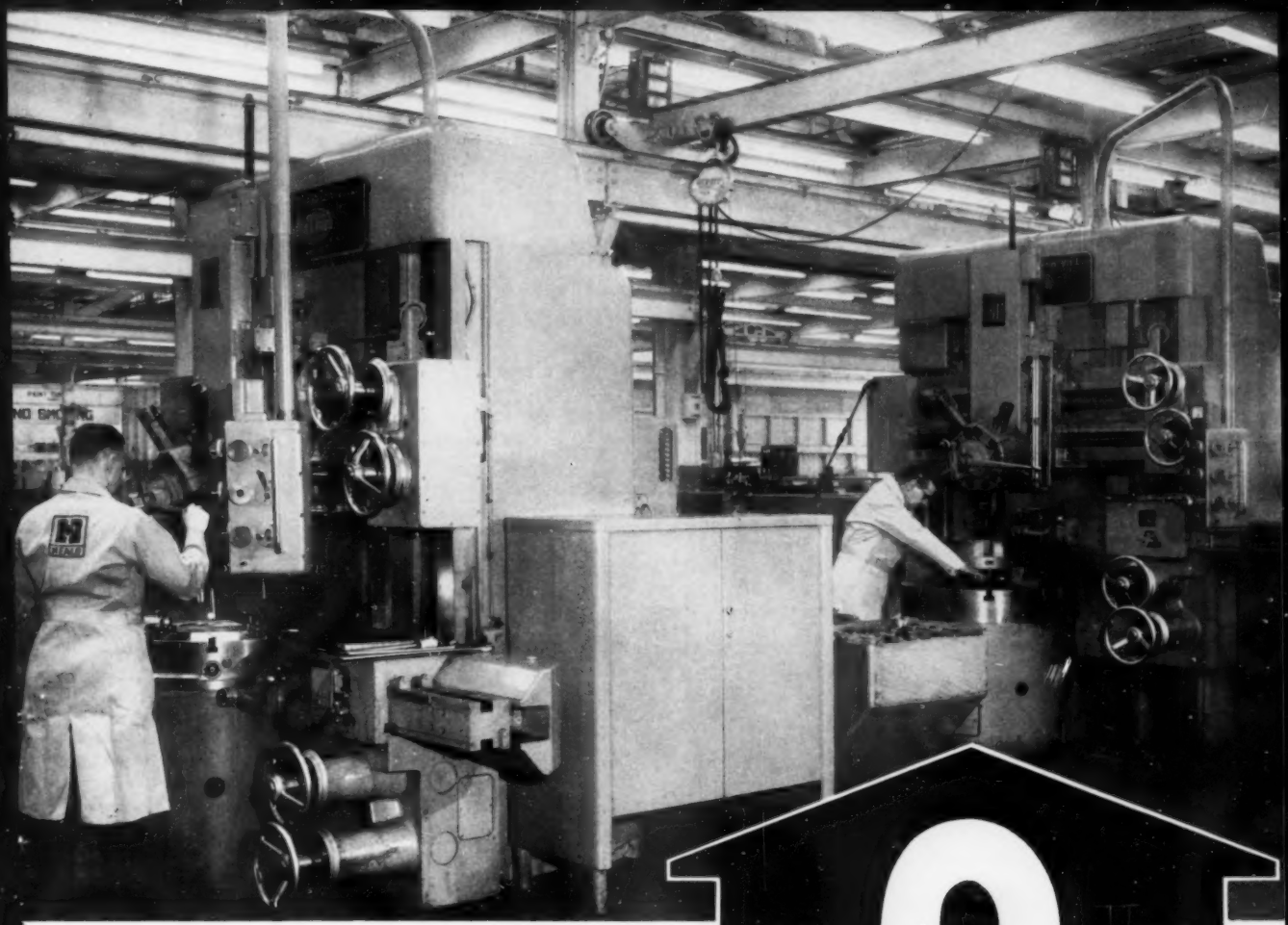

IT PAYS TO REPLACE . . .

A study of the production factors at The Heald Machine Company, Worcester, Mass., pioneer New England builders of precision machine tools, indicated that two Bullard Cut Master V.T.L.'s, Model 75, would produce as many parts, in any given period, as four Bullard V.T.L.'s of an earlier design.

when 2 do the work of four

In actual production, these additional advantages have been experienced:

- Greater flexibility for faster changeover and set up
- Ease of control — less operator fatigue
- Dependability and accuracy on holding size
- Less tool wear, spoilage and inspection
- More rigidity for higher speeds and feeds

This all adds up to more parts at less cost per piece.

Perhaps an analysis, by a Bullard Sales Engineer, of your machining procedures will reveal "hidden savings" for you.

Why not ask him or write.

BULLARD

THE BULLARD COMPANY

BRIDGEPORT 9, CONNECTICUT

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SPS RELIABILITY / *A dynamic standard of predictable performance*

Precision of UNBRAKO Dowel Pins cuts cost in many applications

Precise tolerances of ±0.0001 inch and consistently uniform physical characteristics, maintained by automatic gaging, and atmosphere-controlled heat treatment, make UNBRAKO Dowel Pins reliable cost-cutters in many different applications.

These precision products are so accurate that many plants use them as plug gages in numerous production operations. Others use them as guide pins, stops, wrist pins, hinges and shafts; as position locators on indexing machines; as feeler gages in assembly work; as valves and valve plungers on hydraulic equipment; as fasteners for laminated sections and machine parts; as roller bearings in casters and truck wheels.

Your authorized SPS distributor stocks UNBRAKO Dowel Pins in two types: Blue Label Pins .0002 inch oversize to meet nominal press fit requirements; and Red Label Pins .001 inch oversize for use as repair pins.

See your nearest distributor for complete details. Or write SPS —manufacturer of precision threaded industrial fasteners and allied products in many metals, including titanium.

◀ Typical of the many applications of UNBRAKO Dowel Pins is this die. Here the pins are used to position laminated sections.

Nominal Diam.	STANDARD (.0002 inch over diameter listed)		OVERSIZE (.001 inch over diameter listed)		Point Diam.	Top Radius	Bottom Radius
	Max.	Min.	Max.	Min.			
1/16	0.0646	0.0642	0.0636	0.0634	0.0054	0.015	0.005
1/8	0.1253	0.1251	0.1261	0.1259	0.116	3/64	1/64
3/16	0.1878	0.1876	0.1886	0.1884	0.178	3/64	1/64
1/4	0.2503	0.2501	0.2511	0.2509	0.237	1/16	1/64
5/16	0.3128	0.3126	0.3136	0.3134	0.298	1/16	1/64
3/8	0.3753	0.3751	0.3761	0.3759	0.359	5/64	1/64
7/16	0.4378	0.4376	0.4386	0.4384	0.417	3/32	1/32
1/2	0.5003	0.5001	0.5011	0.5009	0.480	7/64	1/32
5/8	0.6253	0.6251	0.6261	0.6259	0.605	1/8	1/32
3/4	0.7503	0.7501	0.7511	0.7509	0.725	1/8	1/32
7/8	0.8753	0.8751	0.8761	0.8759	0.850	1/8	1/32
1	1.0003	1.0001	1.0011	1.0009	0.975	1/8	1/32

OTHER CHARACTERISTICS OF UNBRAKO DOWEL PINS

- **Surface Hardness:** Rockwell C Scale: 60-62
- **Surface Finish:** 6 microinch maximum
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- **Average Shear Strength:** 150,000 psi
- **Diameter Tolerance:** ±0.0001 inch

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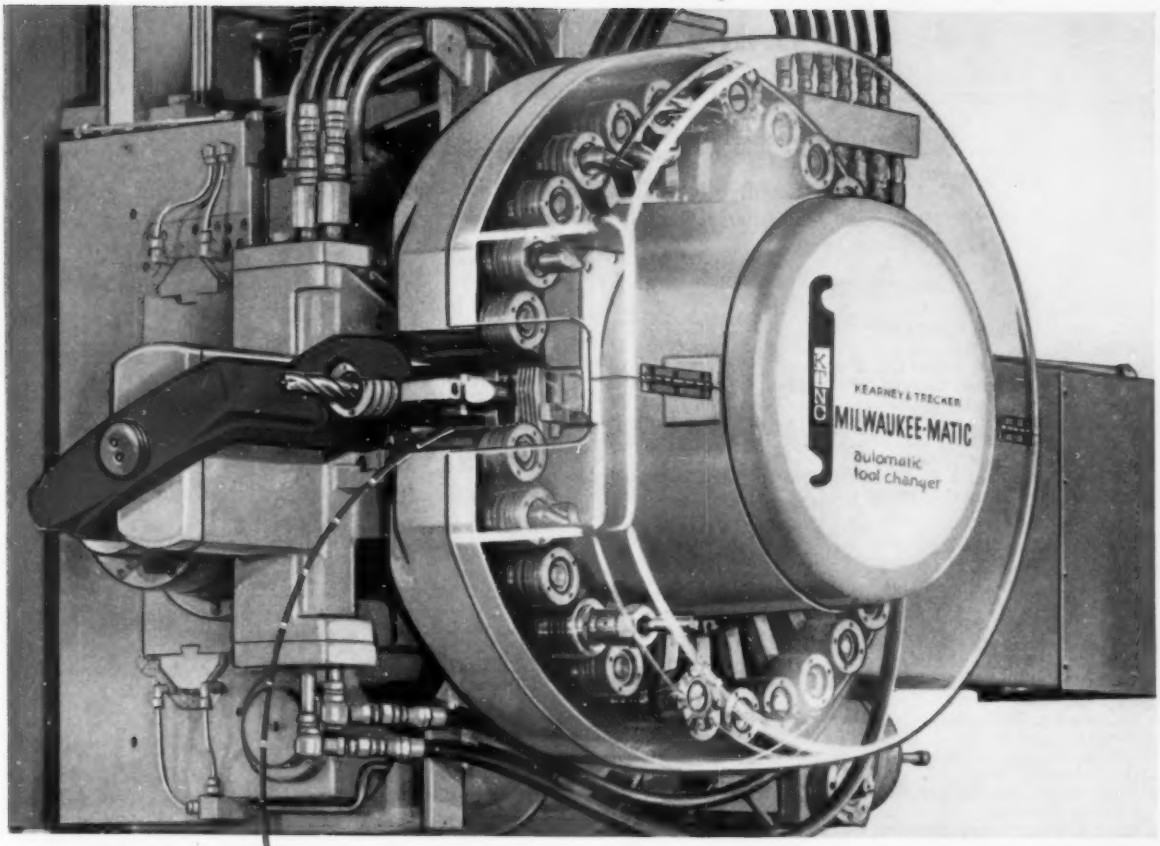

See it in action

RIGHT AT YOUR DESK

Write for this free "Miniature Movie" on the machine that changes production schedules from MONTHS to MINUTES.

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August 1959

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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Lethargy and complacency on the part of American industry are the greatest weapons we can give the Communists in the economic, technical and political cold war, according to Francis K. McCune, General Electric vice president. He recommends that industry shorten the research and development cycle for all goods but cautions against "spectacular international competition for competition's sake." If we must repeatedly prove our technical strength, he stresses, "let us do so in areas where the end result is of greatest security or economic use to the free nations."

Technical strength of the U. S. is unquestionably being improved by the rapid application of automatic controls to manufacturing. At Wyman-Gordon Co., large forging die blocks have been successfully produced under numerical control. A Kearney & Trecker milling machine, equipped with a Bendix control, is used. The ability to produce any number of dies with one tape makes numerically controlled die sinking particularly attractive where large numbers of identical dies are used for high production.

Spectacular savings are being realized through the use of numerical control for production of aircraft and missile components. H & B American Machine Co. reports 55 percent savings in machining time, 38 percent savings in tooling cost and 33 percent savings in lead time for the first part have been achieved by milling Atlas ICBM thrust bulkheads under numerical control. Initial tooling costs are reduced by $3700, illustrating how numerical controls can pay for themselves.

Other applications of numerical control are covered in the article: "Planning for Job Shop Automation" in this issue of THE TOOL ENGINEER.

Tape processing has been something of a bottleneck where a number of numerically controlled machine tools are in use. This bottleneck has been broken at North American Aviation's new tape processing center. A Numericord Director, Developed by Concord Control, Inc. for the Giddings & Lewis Machine Co. is capable of converting punched-tape instructions 16 times faster than was previously possible. It is estimated that where previous processing centers could produce sufficient tape for five machine tools, the new system can service over 20.

Looking ahead, machines and production facilities that will keep track of their own output, check on its quality, compute how effectively they are performing, and even shut themselves off if something is amiss have been predicted by A. E. Kallinich, Veeder-Root vice president. As he points out, such systems are close to realization in fluorescent tube manufacture.

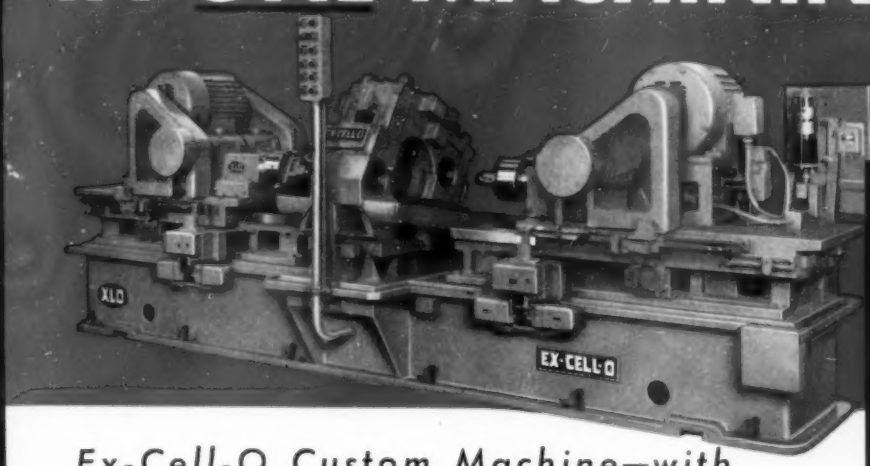
FROM ROUGH...

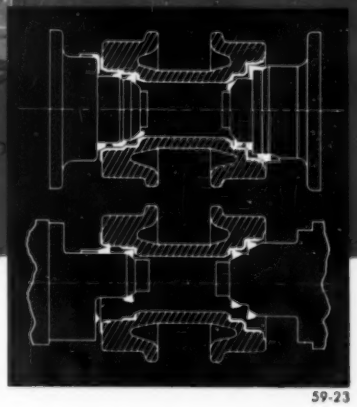
Heavy boring and plunge-facing

TO FINISH

Precision boring and facing

IN ONE MACHINING CYCLE





59-23

Ex-Cell-O Custom Machine—with quick-change tooling—speeds output of large, cast-iron track rollers

This Ex-Cell-O Custom Machine features precision—in a big way.

A track roller for rugged, off-the-road equipment, is clamped in the hydraulically-actuated fixture; the rest—from rough to finish—is automatic.

The part is first rough-bored on both ends at the same time. Then both slides retract and the fixture indexes into position for finish boring and facing at both ends, simultaneously. (Drawing, above-right, shows rough and finish tooling.) Slides again retract and the fixture is unclamped, ready for the next cycle. Easily changed tooling heads and clamping jaws permit precision machining of any of three similar components with minimum lag in production.

See your Ex-Cell-O Representative, or write direct for full details on Ex-Cell-O Custom Machines—specially designed with extended capacity for changing production needs.

EX-CELL-O FOR PRECISION XLO

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Machinery Division

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YEARS – YEARS – YEARS AHEAD

TORC-PAC—A REVOLUTIONARY ENGINEERING ACHIEVEMENT THAT WILL IMPROVE YOUR PROFITS

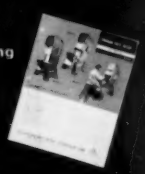
There is no reason to hesitate about purchasing a Torc-Pac O.B.I. just because it's "different." We know it's different! We planned it that way.

The air-friction clutch and brake, for example, is the most improved press drive ever. So, of course, it's the most "different" press drive ever. Most of the wear that you can expect in a conventional clutch and brake simply can't happen in the Torc-Pac. It can't happen because most of the initial pick-up load is applied to the clutch friction plates by oil placed in shear. The complete clutch and mechanically interlocked brake are sealed in oil and require no adjustment or maintenance whatsoever. The friction plates are sintered bronze —a material which will last many years beyond the life of a conventional lining.

The Torc-Pac is to conventional O.B.I.'s what the electric light was to the kerosene lamp. We'd like to explain the many reasons why this is true. Call or write. We'll look forward to hearing from you.

Clearing division of U. S. Industries, Inc. manufactures power presses of all types, Clearing-Axelson and Clearing-Harrison lathes, dies and special tooling, and special equipment for the aircraft and missile industry.

Write for further engineering facts on Clearing's line of Torc-Pac O.B.I.'s.



USI Clearing

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